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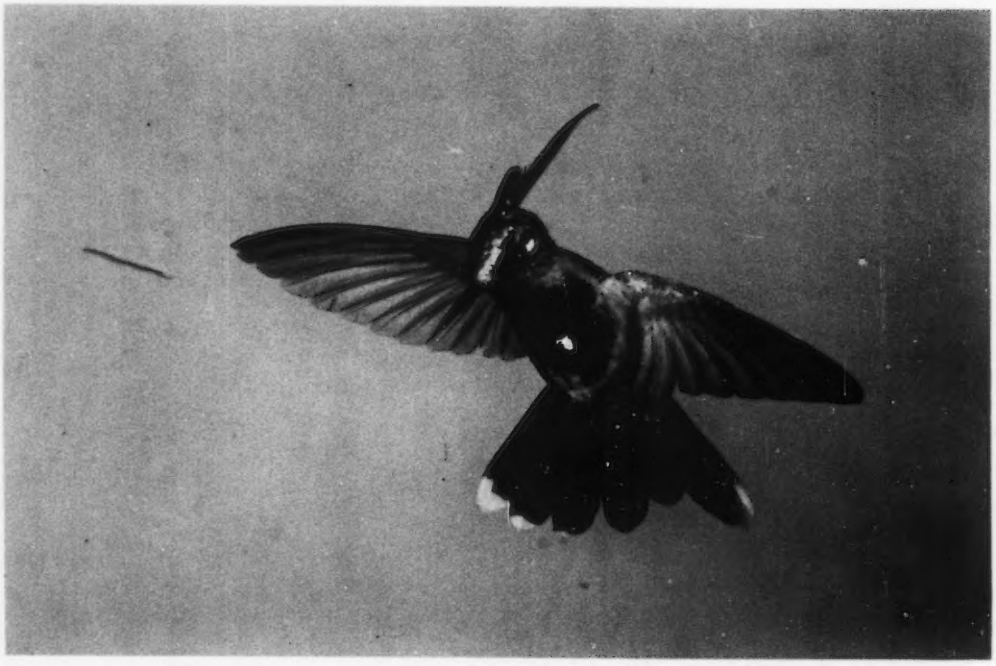


FIG. 1. *Stephanoxis lalandi.* Brazil.

THE IRIDESCENT COLORS OF HUMMINGBIRD FEATHERS

CRAWFORD H. GREENEWALT, WERNER BRANDT, and D. D. FRIEL

E. I. du Pont de Nemours and Company

(*Read November 13, 1959*)

NATURE is at the same time a superb artist, a creative scientist and an extraordinarily accomplished craftsman. One is always astonished at her versatility. It might be expected that having devised a particular solution to a problem she would be content to adopt it universally. Not at all; she seems to delight in parading her virtuosity in showing an admiring world how varied and diverse her craftsmanship can be.

Nowhere is this versatility more evident than in the coloration of animals, and particularly of birds. In this area, Nature has used nearly all of the many methods for producing color, whether they involve the synthesis of complex organic pigments or the creation of physical structures which give rise to color through interference, scattering, refraction, or reflection.

Pigmentary colors in birds appear to be limited to yellows, reds, and browns. The red of cardinal or tanager is due to its pigmented feathers, as are the yellow of canary and goldfinch, the brown of the sparrow, the gray of titmouse or nuthatch.

Blues are produced by the selective scattering of light from minute particles dispersed in the material of which the feather is made. This is called "Tyndall blue," and the mechanism is precisely that which produces the blue of the sky. Bluebird, blue jay, and indigo bunting are examples in which this type of feather coloring predominates.

Greens are a combination of yellow pigment and Tyndall blue as exhibited in parrots and in many other tropical birds.

Iridescence in the coloration of birds is not at all unusual. We see iridescent patches in such common birds as pigeons, ducks, and grackles, as well as in more exotic varieties like the peacocks, the sunbirds, and, of course, the hummingbirds. Intensity of the iridescent colors, however, varies over wide limits, from a barely perceptible colored sheen in the throat of a pigeon to the pure spectral brilliance of the hummingbird gorget.

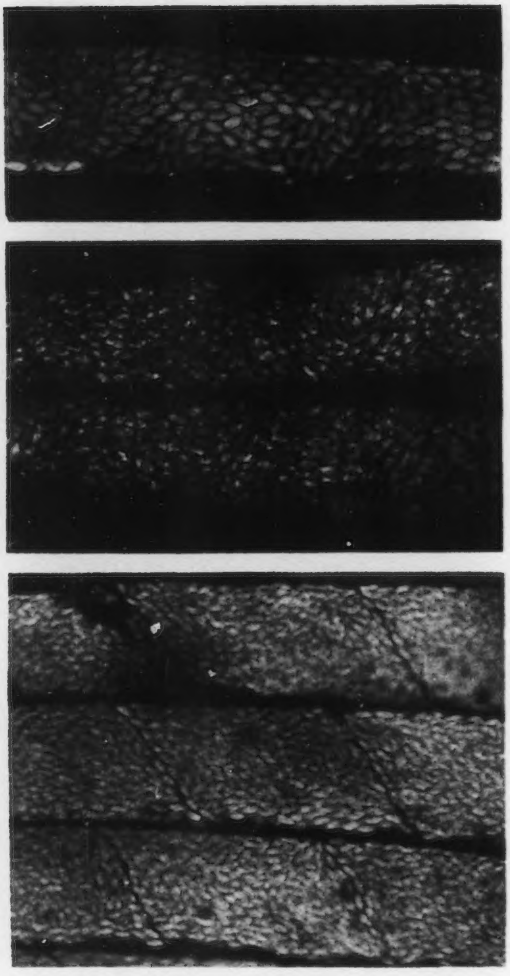
The physical basis for iridescent colors has intrigued scientists for a hundred or more years and a listing of the technical papers dealing with the subject would fill many pages. Newton himself suggested that iridescent colors in birds and insects might be due to the presence of thin films, whose color-producing properties he was the first to observe. (He did not, however, understand the mechanism by which the colors were produced. Interference was a later discovery.)

Recognition of interference as the extinction or reinforcement of light waves casts new light on the problem. For it is clear that, if interference is involved, the color of bird or insect must shift toward the blue as the viewing angle is decreased. There is no other color-producing mechanism which behaves in this way. The experimental method is simple—tilt the feather so that the viewing angle becomes steadily more acute. If the color shifts to the blue (red becomes orange, orange becomes yellow, yellow shifts toward green, etc.), the conclusion is inescapable that some form of thin film interference is involved.

Interference as the cause of iridescent colors in birds was first proposed by Altum in 1857 and, while there have been doubting Thomases in the intervening years, nearly all subsequent investigators confirm his findings. Today, interference as the cause of iridescence is universally accepted.

The nature of the thin film or films is, however, far from clear. It was recognized early in the game that a single film could not produce reflectances as brilliant as those observed in hummingbirds. The sophisticated investigators, therefore, postulated the existence of a number of films stacked on top of each other to account for the brilliance. Until recent years, this theory could not be verified experimentally because the films are so thin that the best of the optical microscopes cannot make them visible to the human eye.

A quite recent study of the colored surface of hummingbird barbules using the highest power of the optical microscope has been made by a German investigator. He found that the surface consisted of a beautiful mosaic of colored elliptical platelets resembling generally a tiled floor. Even



FIGS. 2–4. The reflecting surface of barbules from the gorget of (2) *Heliangelus viola*, (3) *Lampornis clemenciae*, (4) *Clytolaema rubricauda*. Magnification 1,160 ×.

with the best of modern techniques, he was unable to do more than guess at their thickness because of the limitations of optical microscopes. All he could really say was that the platelets were exceedingly thin.

This, then, was the state of our knowledge when the present studies were undertaken.

First, we repeated the examination of barbular surfaces with the optical microscope. We confirmed the presence of the platelet mosaic on the iridescent surfaces of fifty or so hummingbird species. Only the platelets are colored; the interstices are dark. The platelets are minute, about 2½ microns across the long axis of the ellipse, and one micron across the short axis. Ten thousand of them laid end to end would measure a little over an inch.

Their size varies little throughout the hummingbird species which we have examined. The length of 2½ microns is a good average and the limits of variation would be no more than 30 per cent either way.

Along its length the barbule is divided into cells separated by diagonal lines crossing the width of the barbule. At the points where the barbule joins the ramus and where the pennulum develops, the colored platelets disappear and one sees only a few random uncolored or faintly colored ellipses in these areas.

The barbule proper then has a surface which is 15–20 microns wide and 100 microns long, divided by diagonal boundary lines into a series of cells which look like parallelograms, each cell made up of a mosaic of 100 or more beautifully colored elliptical platelets.

We then turned to a quantitative analysis of the irridescent colors. For this we employed a spectrophotometer modified for the rather unusual conditions of observation we were required to accept. Because hummingbird feathers are of such small size, it was necessary to view them under a microscope, and the image from the microscope was deflected onto the slit of the spectrophotometer. The small amount of light passing into the spectrophotometer required an exceedingly sensitive detecting system. For this we used a photomultiplier tube and an amplifying circuit connected to an instrument capable of measuring with the necessary precision currents of the order of 10^{-7} amperes.

We find the curves for the many hummingbird colors to be very much alike. There is a very sharp peak of high reflectance—the reflectance falling off rapidly to nearly zero on either side. By measuring these curves at high and low angles of incidence, we confirmed quantitatively the fact that the color invariably shifts toward the blue as the angle of incidence increases, proving once more that thin film interference is the source of the color.

More significantly the shift in peak wave length for a given change in angle of incidence permits measurement of the mean refractive index of the material producing the interference colors. We find that the refractive index changes from a

higher to a lower value as the color of the feather moves from red to blue. For red feathers, for example, the mean refractive index is about 1.85; for blue feathers, it drops to about 1.5; for green feathers, it has an intermediate value.

These findings lead to the rather unexpected conclusion that Nature either develops a new substance of different refractive index for each color she wishes to produce, or that she makes her interfering films out of two substances, one of high and the other of low refractive index, varying the average by varying the proportion of the two substances. Which of these alternatives is the correct one will become apparent from later experiments.

The spectrophotometer can also tell us one more essential fact, and that is the mean thickness of the film producing the interference colors. An interference peak can occur at several different film thicknesses. The requirement is merely that the retardation within the film causes the wave crests reflected from front and back surfaces to reinforce each other. This can occur for films whose optical thickness is ¼, ¾, 5/4, etc., of the peak wave length. To decide where we are in this series, we must determine whether peaks exist at longer or shorter wave lengths than the one we observe in the visible spectrum.

It is experimentally simpler for us to push our curves toward longer wave lengths; that is, into the infra-red region of the spectrum. When we do this, we find no peaks, but reflectances near zero as far out as we can measure. We must conclude, therefore, that the peak we observe is of the first order corresponding to a film whose optical thickness is one-quarter the peak wave length.

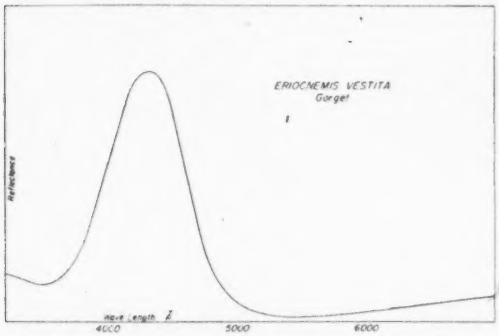


FIG. 5. The reflectance values are relative, not absolute, since it is impossible with the apparatus used to measure the specific reflectance of the barbular surface.

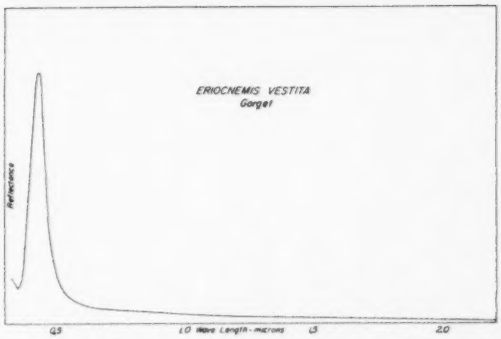


FIG. 6. The same feather for which reflectances in the visible are shown in figure 4.

For a peak in the green, this would imply an optical film thickness of a little more than one-tenth of a micron. We can now easily understand why films of such minute thickness were not observed by previous investigators. Because they are so much thinner than the wave length of visible light, they cannot be seen even with the best of the optical microscopes.

The theory of the reflectance of single or of multiple homogeneous films is well known and it is possible for us to compare theory and observation as far as we have gone. We start with our observed curve for a typical hummingbird feather and plot on the same scale a theoretical curve for a single film with optical thickness one-quarter the peak wave length together with the theoretical curve for a number of such films stacked on top of each other. For the theoretical case, we choose a refractive index of 2.0 for the interfering film and 1.5 (the refractive index of the keratin of which feathers are made) for the other component of the multiple sandwich.

When we do this, we see that neither theoretical curve approaches even remotely the experimental curve for the typical feather. The curve for a single film has too broad a peak and the reflectance is far too low. The multiple layers produce too high a reflectance and the shape of the curve is totally different from the one determined experimentally.

Clearly we must search further.

It seems obvious that we must learn more about the structural details of the platelets comprising the colored surface of the barbule. For this, we turn to the electron microscope. Mr. D. D. Friel was kind enough to undertake the arduous task of preparing the necessary feather cross sections and of photographing them under the electron

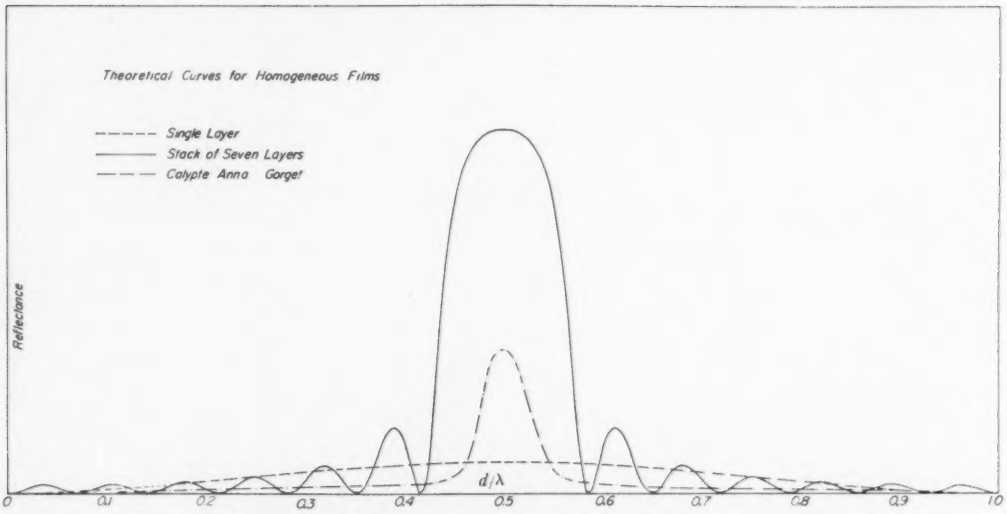


FIG. 7. The theoretical reflectances were computed for films having refractive indices of 2.0 and 1.5.

microscope. The principal difficulty here is that the substance of which the feathers are made is exceedingly tough and to obtain sufficiently thin sections it was necessary to find a plastic imbedding material of hardness identical to that of the feather substance, and a microtome knife sharp enough to cut the sections. After many tries a suitable combination was found, and sections of the order of one micron or less in thickness successfully prepared.

The electron photomicrographs show clearly that the platelets are not homogeneous, but have the appearance more or less of an elliptical pancake made from dough to which baking soda has been liberally added. We find a matrix containing air bubbles which in cross section resembles a very thin foam mattress. This structure, too, is completely consistent with refractive index measurements made with the spectrophotometers. If we assume a refractive index of say 2.0 for the matrix and 1.0 for the air bubbles, we can easily see how the average refractive index for the platelets can vary from 1.85 to 1.5 merely by increasing the air content of the platelet. The electron microscope also shows us that there are eight to ten layers of platelets at the surface of the barbule.

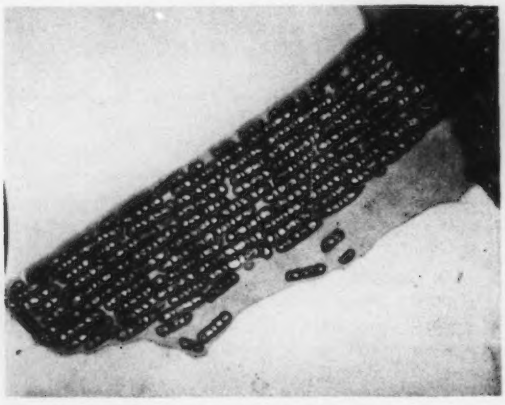


FIG. 8. Section through a barbule from the gorget of *Clytolaema rubricauda*. Magnification 11,700 ×.

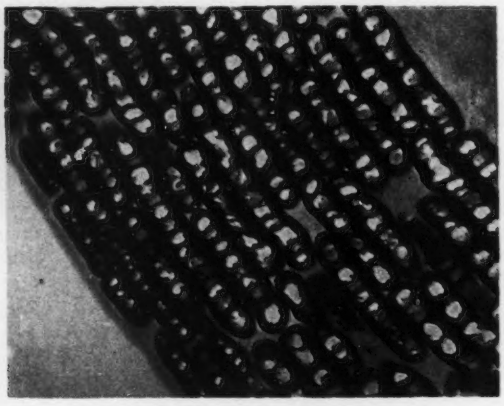


FIG. 9. The same section as in figure 7. Magnification 29,940 ×.

From this we deduce that the platelet has an interference structure which is inhomogeneous, comprising air and some material of much higher refractive index, that the surface of the barbule has eight to ten layers of such platelets, and that the air content increases to produce a lower mean refractive index as the color of the feather passes from red to green to blue.

It remains now to determine whether theory and experiment are consistent. To do this, we must find out whether the theoretical interference curves for a layer of platelets which are not homogeneous will match those we have determined experimentally.

Unfortunately, the literature on interference has little to say about inhomogeneous interference structures, possibly because such films have not been produced artificially and no one has suspected that they would be found in nature.

Dr. Werner Brandt was sufficiently interested in the problem to develop the theory. The mathematics involved is quite complex and a quantitative solution of the problem required the use of a large electronic computer.

To pass quickly over many hours of work by Dr. Brandt and many millions of computations by the indefatigable computer, we find that theory and experiment are indeed consistent. The observed spectrophotometric curve can be matched very nicely by assuming a stack of three or so platelets, each platelet being made of a matrix of refractive index 2.0 and containing an adequate proportion of air bubbles of refractive index 1.0.

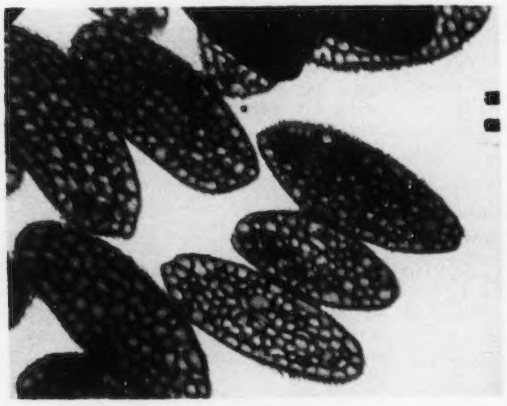


FIG. 10. Single platelets from the crown of *Chrysolampis mosquitus* viewed from above. Magnification 24,600 ×.

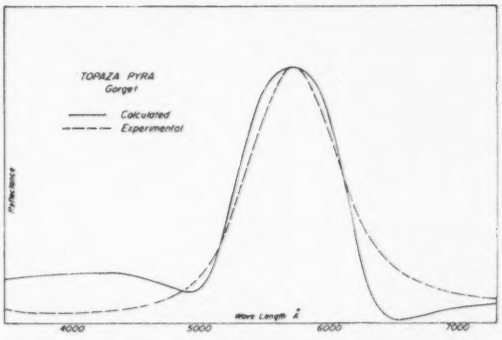


FIG. 11. The calculated curve is for three layers of platelets.

It turns out also that each platelet behaves as if it were in reality two films, each with an optical thickness one-quarter of the peak wave length. When we speak of whole platelets their optical thickness will be one-half the peak wave length and their true thickness the optical thickness divided by the mean refractive index. Here also theory and experiment are in agreement. Platelet thicknesses, measured from electron photomicrographs are the same within experimental error as those computed for the theoretical case.

To summarize, hummingbird iridescence is due to interference colors produced by a stack of about three films whose optical thickness is one-half the peak wave length. Each film is a mosaic of platelets of elliptical form. Each platelet is about 2½ microns long and one micron wide. The platelets are not homogeneous and consist of air bubbles encased in a matrix of refractive index about two. The different hummingbird colors are produced by a combination of effects. The platelet thickness decreases moderately as one passes from red through green to blue, and the air content increases simultaneously. In theory, of course, platelet thickness could remain constant and the color change would arise solely by variation in air content. Conversely air content could be constant and the platelet thickness varied. Nature for reasons best known to herself has elected to vary both factors together.

We do not know whether or not similar structures are found in the feathers of other birds having iridescent colors. However, the techniques developed in this study could be applied with relative ease, and we hope as time permits to carry these studies to other avian families.

EXCAVATIONS AT DZIBILCHALTUN, NORTHWESTERN YUCATAN, MEXICO

E. WYLLYS ANDREWS

Associate in Archaeology, Middle American Research Institute, Tulane University

(*Read November 12, 1959, by Robert Wauchope, Director, Middle American Research Institute, Tulane University*)

INTRODUCTION

AIDED by generous grants from the National Science Foundation and the American Philosophical Society, the National Geographic Society and Tulane University have completed three seasons' excavation at the ruined city of Dzibilchaltun, 10 miles north of Merida, Yucatan, Mexico, and about an equal distance south of the coast.

Dzibilchaltun was one of the largest, if not the largest Pre-Columbian city in the New World. Archaeological remains are densely distributed over an area of approximately fifty square kilometers. About ten of these, near the center of the site, were built up into a massive ceremonial center. Scattered over the remainder of the area are smaller groups of ceremonial construction, often of considerable size. Between these groups are almost continuous low house mounds and occasional vaulted stone buildings.

Dzibilchaltun's unique scientific importance, however, lies not in its size but its remarkable period of occupation. The great cities of the southern lowlands were all abandoned in the seventh century, with possibly occasional sporadic reoccupations. The well-known cities of Yucatan such as Uxmal, Chichen Itza, and Mayapan were inhabited only for brief centuries—and their periods of occupation by no means always overlapped. No remains were known in Yucatan paralleling the early period of grandeur of the metropoli of the southern rain forest. Our record, therefore, was an incomplete one. We had no yardstick covering the many phases of the rise and fall of Maya civilization.

As our work progressed it soon became clear to us that Dzibilchaltun was what had so long been sought. It was the seat of continuous, large population uninterruptedly from early pre-Classic times until the present day—a span of at least 3,500 to 4,000 years, perhaps longer. Of equal importance, this record was available to the archaeologist in the form of clear vertical stratigraphy, so that there would be no doubts as to the precise sequence of the many temporal components. Furthermore, the early part of this developmental sequence in architecture, ceramics, and art, is firmly tied by abundant trade pottery into the established partial sequence in the southern cities, and therefore into the Maya "Long Count" Calendar. Its final stages are firmly anchored in the Christian Calendar.

PROGRESS TO DATE

During the first three seasons, systematic excavations have been made in remains beginning with the second phase of what has been called the "Classic Period" in Guatemala, and extending to post-conquest times. A detailed, uninterrupted stratigraphic record has been obtained of the ceramics, architecture, and art of this long span of time—and at least a preliminary view of the radically changing settlement patterns which characterized the various periods involved. The unfamiliar period names which we shall use in the following brief summary will be explained in more detail in pages below.

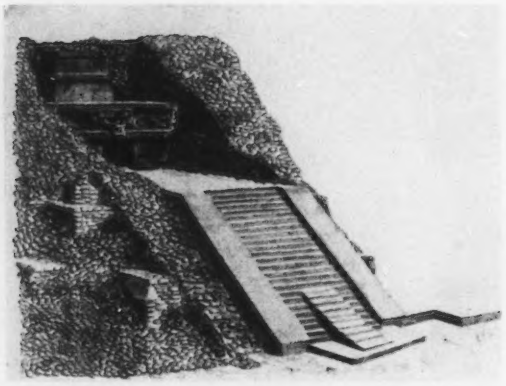
At the bottom of this sequence, Structure 1 (The "Temple of the Seven Dolls"), a large buried pyramid temple dated by C^{14} at A.D. 475 (and by an abundance of ceramic tradewares as contemporaneous with the beginning of the Tepeu 1 phase of the Guatemala "Classic"), has been completely excavated and restored. Two other structures (14, 57) completely excavated and partially restored, document later phases of the Early Period traditions in architecture in sealed association with large ceramic collections. Trade wares from the Peten indicate that these may be dated at the beginning and at the end of the Tepeu 2 phase in Guatemala.

A number of excavations were undertaken in the "Palace Group," a massive quadrangle of buildings just south of the main plaza, with more than one hundred rooms in its component structures. Construction of this group was begun at the northern end during the Early Period, after which there was a gradual but clear transition to later architec-

FIG. 1. Dzibilchaltun, Structure I (sub), at the end of the 1958–1959 season. This was built at the start of the second phase of the Early Period, about A.D. 475. Later, but still in the Early Period, the building was covered by a much larger pyramid. A portion of this later structure may be seen at the right, its plan marked by the single course of stone in the foreground and at left.

tural styles, culminating in the west and south wings in pure Florescent tradition. A series of trenches was dug in refuse heaps in the early part of the Palace, and three structures were completely excavated last season (95, 95A, 96) in order to obtain a large sample of pottery in sealed

FIG. 2. Dzibilchaltun, Structures I–XII, Stela 3. Preliminary reconstruction by George E. Stuart. Structures II–X formed an enclosed precinct around Str. I. Between the surrounding structures was a stone wall, approx. 2 m. tall. The group was apparently abandoned at the close of the Early Period, and fell into ruin during the following Florescent.



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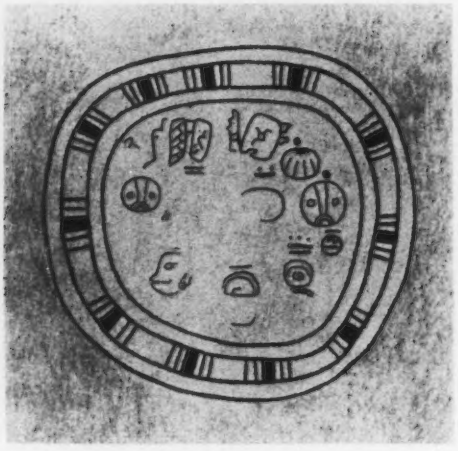


b & c

association with pure Florescent architecture. The results of these excavations indicate that there is a period of transition between Early Period and Florescent styles that corresponds roughly to Tepeu 3 in the South. Pure Florescent styles at Dzibilchaltun, contrary to most current conceptions, definitely post-date Tepeu, and therefore the abandonment of the southern cities.

Directly following the pure Florescent, in a stratigraphic sequence at Structures 36–39, was found the Modified Florescent ("Toltec"), which elsewhere characterizes the major occupation of Chichen Itza. The distinctive ceramics of this period, at first unmixed in the stratigraphy, suddenly give way to a completely different complex of wares (black-on-cream), prior to Dzibilchaltun known only as surface material at Chichen Itza, and found at the bottom of the brief Mayapan stratigraphy, already associated with the redwares typical of the Decadent Period. We had long suspected that this indicated a chronological gap between Chichen and Mayapan, probably representing the temporary hegemony of some as yet unknown site. This unknown site may well have been Dzibilchaltun, for in stratigraphic association with at least three phases of architecture forming a stylistic bridge between the vastly different techniques of the Florescent and the Decadent, we find ceramics in this "black-on-cream" tradition first in pure samples, later mixed with, and finally giving way to the redwares of the Decadent Period. We have, without question, a clear period of transition, marked by the rise and fall of a distinctive pottery tradition, which again must be spliced into currently accepted chronological frameworks.

The Decadent (Mayapan) Period was also one of considerable population at Dzibilchaltun. Major architectural efforts, including the rebuilding of the west façade of the pyramid below the Temple of the Seven Dolls, accompany a thick deposit of

FIG. 3. Dzibilchaltun. *a*. Structure I during the Decadent Period. Preliminary sketch by George E. Stuart. After abandonment during the Florescent Period, this structure was reoccupied by the Decadent Period priests. A new (3rd) stairway was built directly over the lower half of the second period structure. A tunnel was then cut into this structure at a level about halfway up the doorway of the First Period Structure inside. Stone fill was removed from the front hall and Central Sanctuary, an altar built closing the rear doorway of the sanctuary, and the area was used as a shrine over a period of at least five renovations. *b* and *c* are reproductions of two of a series on at least four hieroglyphic texts painted in medallions on the center of the altar during various renovations.

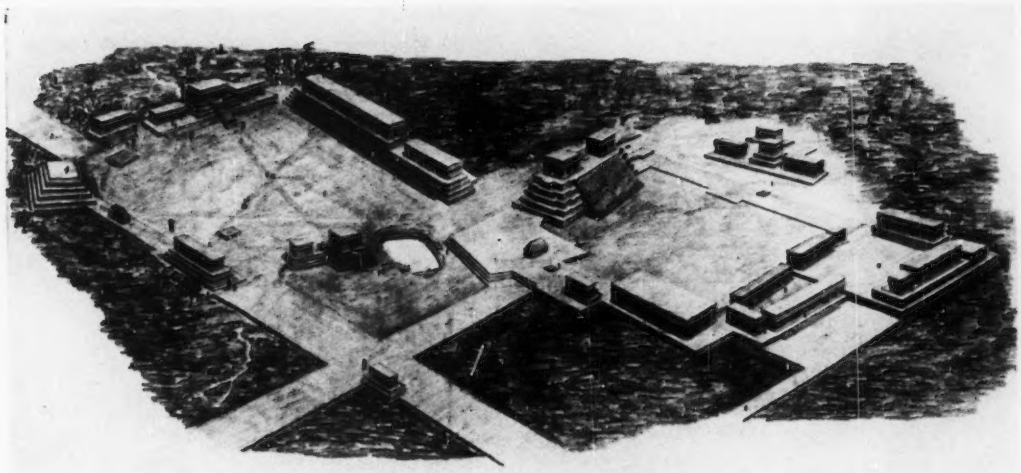


FIG. 4. Dzibilchaltun. Preliminary restoration of Central Group by George E. Stuart. Although numerous details of this 1958 sketch already need correction, and many more will appear in the course of work, this gives an excellent idea of the orientation and general form of the largest group at the site. The cenote mentioned below on this page is at the center.

Decadent Period redwares and unslipped pottery over the central and various peripheral portions of the site. There was sufficient population at the site shortly after the Spanish Conquest to warrant the building of a Catholic church in the center of the old Great Plaza.

This church, apparently built in 1593, was removed with its santo twenty-four years later to the modern village of Chablekal, some 1,700 meters to the East. The present population of the ruined zone inhabits not only the *pueblo* of Chablekal, but also those of Komchen and Xcanatun, and a number of large haciendas. Subsequent to the First Phase of the Florescent Period, various of the vaulted stone structures were used as simple dwellings. Deep, well-stratified middens help us to analyze the non-secular life of these later inhabitants and their changing patterns of settlement at the site. Some of these middens carry us not only beyond the Spanish Conquest but on into the nineteenth century before the vaults of the old structures collapsed.

Our major goal in these excavations has been the establishment of a solid, complete stratigraphic column of history within which we can find for the first time an uninterrupted and sealed association of the development of ceramics, art and architecture during the surely more than three thousand years that the site is known to have been inhabited. Back to the First Phase of the Early Period, this has now been successfully done.

In addition to this prime job, various ancillary projects have been undertaken which will contribute greatly to our broader knowledge of the culture of the people we are studying. To mention only a few:

(A) George E. Stuart is now entering the third season of work on a detailed map of the entire 50 sq. km. zone which, when finished, will offer us not only a uniquely detailed view of a Maya site, but a wealth of data on the changing patterns of settlement and construction over several millennia of history.

(B) A group of divers spent three seasons doing underwater archaeology in a deep well or *cenote* in the central ceremonial plaza of the site. More than 30,000 pieces of pottery and artifacts were found, including a surprisingly large number of whole pottery vessels which will be a great help in reconstructing the fragmentary material from our surface trenches, and a wealth of small artifacts, some exquisitely carved, apparently placed in the *cenote* as cult offerings. Certain categories of these artifacts, such as wood, are unique in that the materials never survive the annual changes from dry to water-soaked conditions on the surface.

(C) Dr. Alfredo Barrera Vasquez, through the cooperation of the Instituto Nacional de Antropologia e Historia, has been able to devote consider-

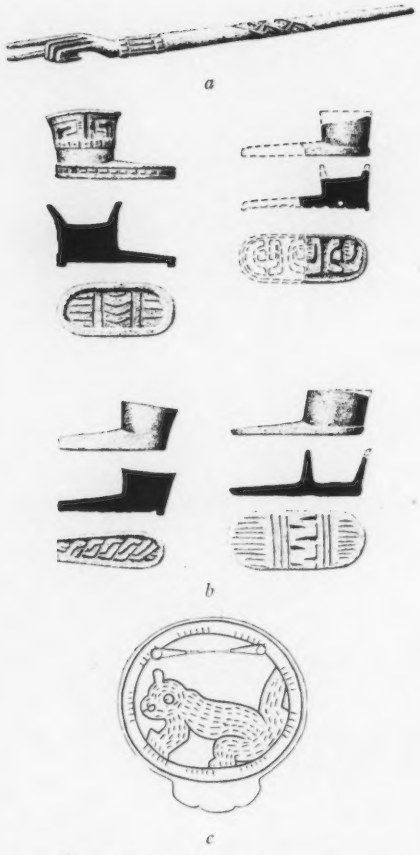


FIG. 5. Dzibilchaltun. Wooden artifacts recovered from cenote. Perfectly preserved under the water, artifacts of this material almost never survived on the surface where continuous changes from dry to wet soon resulted in decomposition. *a*. Carved arm and hand with pointing fingers; *b*. Carved labrettes; *c*. Medallion carved with squirrel (?). Scale 1:2.

able time to a study of the conquest period sources and early chronicles in an attempt to locate this vast site in early native tradition. His preliminary studies have now been published, and future work will add further understanding to the ethnological understanding of the site.

(D) Working under a special supplementary grant from the National Science Foundation, Colonel William F. Friedman and his wife Elizabeth, outstanding scientific cryptographers, have spent parts of two seasons in Merida, assisted by Dr. Barrera, acquiring an increasing mastery over the Maya tongue as a pre-requisite for an attack on the phonetic (or at least phonemic) structure of Maya glyphic writing via the advanced interpretive techniques developed by scientific cryptographers since the advent of World War II, where Colonel Friedman made such striking contributions.

PUBLICATION OF RESULTS

The record of these investigations, which now comprises several thousand pages of typewritten notes and drawings in our field notebooks, could not be properly condensed in such a short paper as this to document factually the conclusions we believe they indicate. It is our policy not to attempt individual preliminary publication of the considerable number of segments of such a large dig as they are finished, or to publish striking individual finds as they appear. Lacking the perspective of a completed job, we do not feel we know yet what items are and are not worth publication, or what will later be mere duplication of data. Our critical judgment is not yet sufficient to evaluate these single items of information in terms of the picture as a whole. And, once preliminary factual publication has been made, there is always the temptation to avoid proper synthesis later when it becomes feasible. However, even though final factually documented presentation of our results will be several years in the future, the raw data will be continuously available to interested colleagues in our collections and laboratory records.

HISTORICAL PERSPECTIVE

Therefore, rather than attempt in this short paper to skim over our factual product, we will attempt to summarize what changes it seems to indicate in our broader view of the prehistory of the area. In doing this, we shall attempt to put into precise terms two distinct categories of conclusions which seem indicated by our brief incur-

FIG. 6. Carved wooden mask from the cenote, carved rock crystal plug in mouth. Representation of Mexican *Ehecatl* (?). Actual size.

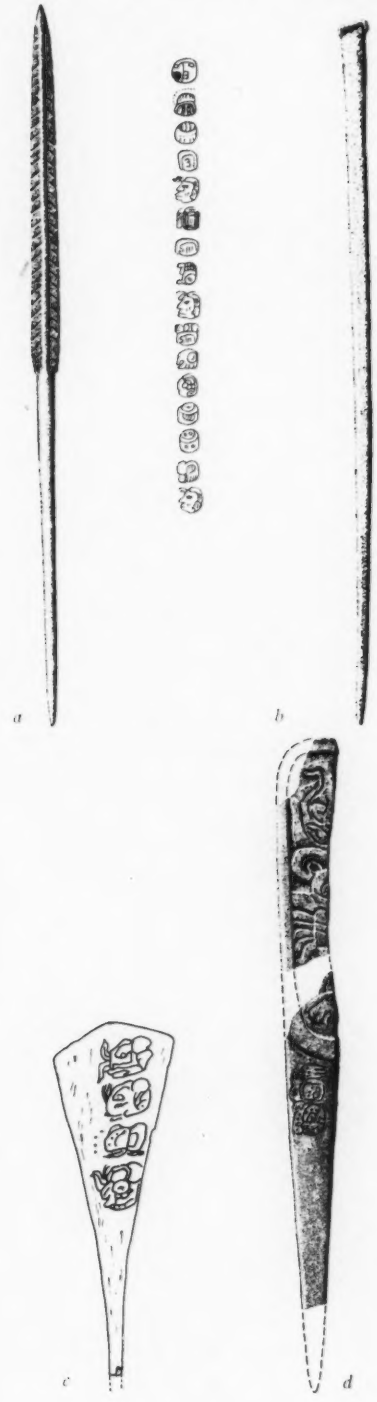


FIG. 7. Carved bone hair skewers (?) from cenote. *a*. Sting-ray spine, frequently associated with votive offerings in tombs and caches at site. *b, c, d*. Note hieroglyphic inscriptions. Scale 1:2.

FIG. 8. Dzibilchaltun. Stela 19. This monument was broken up and re-used in substructure wall of Structure XXXVI. Drawing by George E. Stuart.

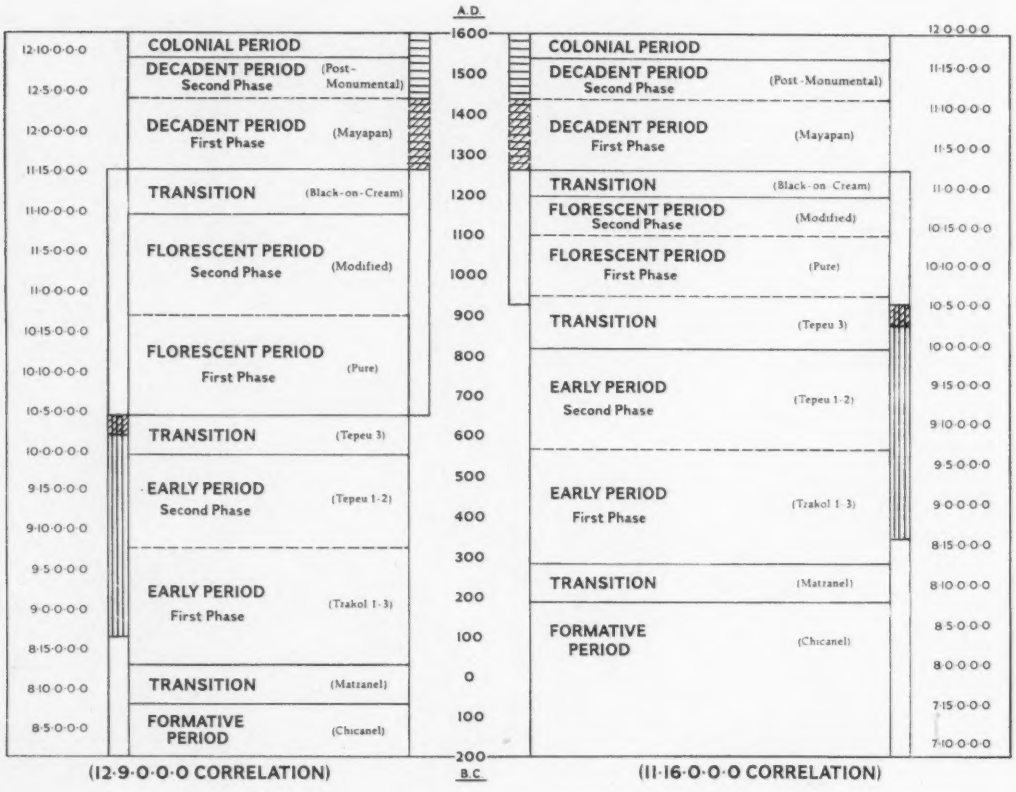
sions into various disciplinary approaches to the study of Maya culture which we feel have too long been viewed as studies in themselves rather than mere aspects of a single cultural development.

First, it seems to us that existing cultural taxonomies of the Maya, if one can thus describe the rough ordering of cultural evolution into significant stages of development, have thus far been influenced excessively on the one hand by sporadic eras of maximal and minimal influences from foreign areas, and on the other by long established and successful stratigraphic sequences in areas where only a segment of the cultural continuum is to be found. We feel that viewing this continuum for the first time from a site where the totality of Maya culture is apparent as a single sequence, a much different basic pattern appears. It is based neither on the varying waves of impact from outside areas which any civilization experiences (and the Maya did not live through their long history at the center of a cultural vacuum), nor on the apparent rise and fall of sub-areas where only a part of the total continuum was observable, but rather on the basic techniques in the many aspects of higher culture which distinguished the Maya from peoples (and civilizations) elsewhere.

Second, certain facts now emerging from our work seem to throw some light on the problem of the relation in time between the Maya culture and the world beyond—including the relationship of what still remains in considerable part a "floating chronology" with our own system of time-reckoning. In this second category, our suggestions are on much less firm ground.

Indicated conclusions in both categories are schematized in table 1, the basic taxonomy fitted alternatively to what seem to be the two most acceptable orderings in absolute time. It will be noted that the zones bracketed by vertical shading are fixed with reasonable certainty in the Maya "Long Count" calendar, those bracketed by horizontal shading are fixed with equal certainty in our own calendar. Adjacent segments less certainly fixed in the two calendars are cross-lined with

TABLE 1



diagonal shading. The length of the unshaded areas between is, needless to say, the determinant in our choice of a correlation of the two calendars. The taxonomy and its chronological implications are summarized in separate sections below.

CULTURAL EVOLUTION

All available evidence seems to point to three basic cultural traditions in evolved (post-Formative) Maya Civilization. It is imperative, if we are to view this development impersonally, that we at least reserve judgment on pre-existing terminology which has so long axiomatically defined the last phase of the Early Period (followed by the abandonment of the southern cities in the Guatemala lowlands, Honduras, and Chiapas) as the "climax phase" of Maya civilization. It is equally imperative that we establish our definition of critical periods on basic techniques and media of expression (which we believe are the proper criteria of cultural continuities) rather than modisms of temporary subjective expression which eventually passed without leaving a deep mark on the basic cultural integrity of the artisan. In reference to these latter criteria, we can only point to the continued ethnic, linguistic, and physical integrity of the Yucatec Maya—whose basic structure even today seems little influenced by factors which in their archaeological past have been construed as determinants.

The three basic traditions which we define seem to fall beyond question in chronological order, and should therefore also be considered as horizons in time. Geographic association, and the consequent possibility of time lag, are secondary, and will be considered in the following section. The basic traditions and the broad periods which they define are, in our suggested terminology:

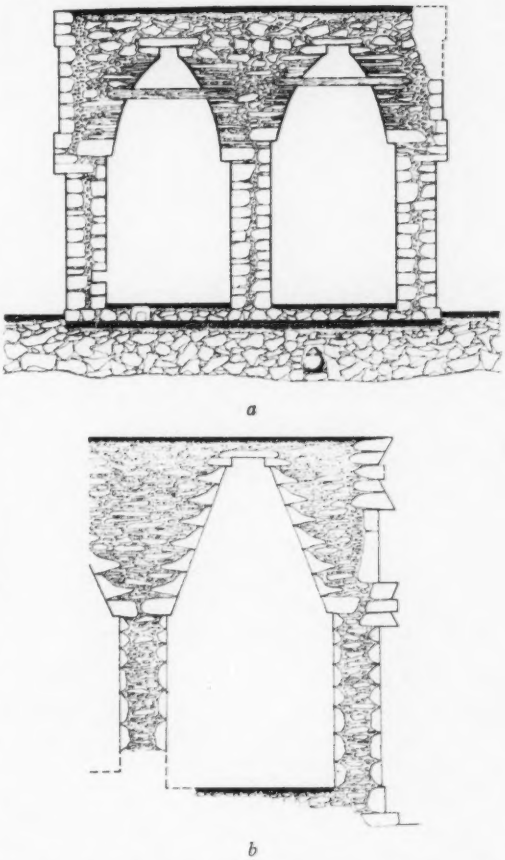


FIG. 9. Sections showing typical masonry techniques of the Early Period and the Florescent Period. *a*. Dzibilchaltun, Structure LVII, late Early Period, cross-datable by sealed pottery with Tepeu 2 in the Peten. *b*. Typical Florescent construction, detail of House of the Turtles, Uxmal.

THE EARLY PERIOD

Early Period architecture is characterized by true masonry construction. Walls are built of large stone blocks which actually bear the weight of the structure. Vaults are made of flat unworked slabs of native rock, corbelled on each side until they can be capped by a final massive slab. During the first phase of the period, the wall blocks are only crudely squared and, as they are largely unmatched in size, coursing is very irregular. In the second phase blocks are pecked (but never ground) to a smoother surface, more carefully sorted and therefore coursed. Vaults, given only the roughest face by the carelessly laid slabs of the first phase, are more carefully constructed during the second, at which time courses of specially shaped stones (e.g., for vault spring) appear. But during the entire Early Period the finished wall surface was formed by considerable spalling and a thick coat of stucco. Façade profiles are simple and rectangular. Architectural decoration was achieved entirely in the medium of sculptured stucco. Architectural carved stone decoration was rare, entirely absent in Yucatan.

In art the cult of stone monuments was the outstanding medium of expression, although all sites used elaborately carved stucco in architecture and

certain sites (Palenque, Acanceh) excelled in this medium.

Associated with monumental sculpture this was the period of the Initial Series (Long Count) in the inscriptions.

In pottery, both in Yucatan and in the south, the Early Period is one of glosswares. A very high degree of proficiency in decoration was reached in the southern area, both in painting and in various techniques of surface alteration. But in the technological sense, the pottery was not first class. Far back in the Early Period a far different family of wares appears in the Dzibilchaltun stratigraphy—the slatewares, which achieved dominance in all populated areas of Yucatan during the following period. These wares are always of a beautifully fired, hard paste, with a distinctive thick, non-glossy slip. Painted decoration is secondary and crude in the slatewares, although carving is often of striking beauty.

THE FLORESCENT PERIOD

The basic techniques as well as the finished products of the Florescent Period architecture are about as different from those of the Early Period as they could be. Block-wall and slab-vault masonry gives way to pure concrete construction. Over this concrete on the walls is a thin veneer of beautifully faced, perfectly rectangular blocks, ground to a fine finish instead of roughly pecked as in the Early Period, and with no functional bearing surface whatsoever. The stone facing of the concrete vaults is of equally finely smoothed blocks, deeply tenoned at the rear to hold them into the matrix they covered. Façade profiles become complex with multi-member mouldings. The naturalistic stucco carvings on the upper façades of the Early Period are replaced by elaborate, highly conventionalized mosaics in carved stone on both upper and lower zones.

Monumental art became much less emphasized during the Florescent. Art in general became a secondary technique to architecture, increasingly conventionalized as the period progressed.

Early in the first phase of this period, the practice of recording hieroglyphic inscriptions on stone seems to have been discontinued.

In pottery, the family of slatewares became dominant in the first phase and remained so throughout the period.

At the close of the first phase of the Florescent, very marked changes occur in architecture, art, and pottery—reflecting the arrival of strong influences from continental Mexico. The great Florescent cities of the Puuc area were largely abandoned and Chichen Itza apparently became the foremost political and ceremonial center of the peninsula. Dzibilchaltun, although strongly influenced by these changes, continued as a major center of population.

It should be emphasized at this point that by including what used to be called the Puuc and Mexican (or Toltec) periods as phases of a single period we are not discounting either the importance of the newly arrived continental influences or their strong if temporary effects on the life of the times. What we wish to underline is that these influences were something only temporarily superimposed on the continuum of Maya culture, the basic techniques of which remained unchanged throughout both phases. New elements in design, new shapes in pottery, new plans for buildings appeared, but these were expressed by the same basic techniques, presumably by the same artisans. In each field of expression, the products of these two phases much more closely resemble each other than they do those of the periods preceding or following, where much more profound changes took place.

THE DECADENT PERIOD

The Florescent was followed by a period of cultural change similar to that described bridging the great gap in traditions between it and the Early Period. The black-on-cream ceramic complex, which served as our original basis for postulating this period of transition, was associated in sealed stratigraphy at Dzibilchaltun last season with a similar pattern of architectural change. So the drastic change from Florescent to Decadent no longer seems so inexplicably abrupt.

By the time of the evolved Decadent (if such a term is permissible) as best seen at Mayapan, there was an almost total abandonment of the techniques which characterized Florescent architecture, and a return to those of the Early Period. Concrete and veneer have been replaced by the old block-wall and slab-vault construction, carved stone replaced by stucco ornamentation. Where the Mayapan architect strove to duplicate external forms of the Modified Florescent (which he often clearly did), he frequently failed because the essential techniques had been lost.

The Mayapan sculptor, again striving to copy much from the Modified Florescent, often failed. And most of his efforts in stone were finally finished in stucco, often very crudely.

In terms of return to Early Period practices, it is interesting to note that several painted inscriptions of the Decadent Period at Dzibilchaltun mark a return to public ceremonial use of the old Maya Calendar, discontinued early in the first phase of the Florescent (*cf.* fig. 3).

In pottery we again find the complete abandonment of the techniques of the Florescent. The beautifully fired hard paste of the slatewares disappears in favor of soft and often crumbly gray paste. The remarkable "waxy" slip of the slatewares disappears, to be replaced by something much more closely resembling the Early Period glosswares (Vaillant originally named the redwares of the Decadent Period "Lacquer" wares). As in architecture and art, the potter copied designs and shapes of the preceding period, but failed miserably to achieve the desired effects because the essential techniques had again been lost. This tendency in pottery is most evident in the shortly post-Florescent transition "black-on-cream" horizon, where it is seen in both shape and design. By the time of the Mayapan redwares, it was less impressive.

ETHNIC IMPLICATIONS

The differences between the three period-horizons outlined above are so striking, with roots so deep into the culture, that one would be inclined at first appraisal to assign them to some actual ethnic shift. It looks very much as if twice during the course of Maya history there was some drastic housecleaning in the basic crafts of the people—as if, indeed, new artisans had been brought in in all fields of endeavor, and these artisans had assumed the task of carrying on the artistic heritage of their predecessors with a very different set of tools. To the cultural historian this would normally (and simply) imply some ethnic shift, wherein new people sharing the same larger cultural perspectives moved in and took over stewardship. In the first case the new artisans outdid their predecessors. For the architectural perfection achieved by the Florescent craftsman can probably be regarded as the highest degree of technical perfection reached in the aboriginal new world, and the ceramists of the age needed to apologize to no one. In the second case, the new trustees were unequal to their trust, possibly as a result of the political upheavals starting in the second phase of the Florescent, and the level of Maya culture declined rapidly into the chaos shortly preceding the arrival of the Europeans.

Alternatively, the material evidence might well be interpreted to suggest that the Florescent tradition ("Puuc" *and* "Toltec," for these are, as we have explained, fundamentally the same) was the result of the intrusion and subsequent withdrawal of some distinct ethnic group, leaving the original population to revert to their original cultural techniques (which certainly happened) over which they had lost mastery during the long period of control by intrusive Florescent elements.

But evidence presented in the preceding pages somewhat complicates the picture. Between the Early and the Florescent Periods we have found clear signs at Dzibilchaltun and Yaxcopoil of periods of evolution from one tradition to the other. Last season at Dzibilchaltun we found clearly associated ceramic and architectural evidence of a similar interregnum bridging the gap between Florescent and Decadent traditions. This would seem to point less toward a sudden shift of population and more toward an undisturbed evolution of local culture.

The traditions themselves are unmistakably clear. The cultural and ethnic factors underlying their sequence deserve much more thought.

IMPLICATIONS IN ABSOLUTE CHRONOLOGY

Our discussions to this point have involved the sequence of development within Maya civilization, with no reference to its placement in absolute time. Table 1 orders the data thus far presented in terms of the two most widely discussed synchronizations of Maya and Christian chronology—that of Herbert J. Spinden, almost universally followed until a generation ago, and that of J. T. Goodman as refined and much more thoroughly documented by J. Eric Thompson, which has held sway in academic circles since that time. The Spinden correlation (placing the Spanish Conquest at roughly 12.9.0.0.0. in the Maya calendar) dates events in the Maya "Initial Series" period about 260 years earlier than the Goodman-Thompson correlation (which places the conquest at roughly 11.16.0.0.0. in the Maya calendar). A group of "later" correlations have not been included for reasons which will be apparent shortly.

It will be noted in table 1 that, regardless of correlation, a considerable segment of the Early Period is directly associable with the Maya Long Count calendar, which went out of use (at least on monumental inscriptions) early in their tenth cycle. At the other end of the scale, the end of

the first phase of the Decadent Period and subsequent events are datable in Christian chronology.

In table 1, the stratigraphic levels associated with the Maya calendar are outlined in bands of vertical shading, those associated with the Christian calendar in bands of horizontal shading. Less certain but probable extensions of these time zones are cross-lined by diagonal shading. The intermediate levels, unshaded, have not yet been directly associated with either calendar. The time span allotted to this blank zone is the crux of the correlation problem, varying in length according to the correlation chosen. On non-epigraphic grounds, we would choose the correlation defining the time span most in accord with the historical developments we know to have taken place therein. This critical span is allotted roughly 500 years by the Spinden correlation, 250 years by the Goodman-Thompson correlation, and virtually no time at all under the later correlation (11.3.0.0.0.) suggested by Vaillant and others.

Even with choices as broad as those given, the dirt archaeologist has been unable to give a definite answer, because in the area where these critical phases of Maya history were concentrated no complete cultural stratigraphy had yet been found. We have now found that complete stratigraphy at Dzibilchaltun, and by means of abundant trade pottery have been able to establish secure relative cross-datings with the carefully worked out Peten sequence. When this stratigraphy has been properly analyzed, sufficient information should be at hand to give the definitive answer so long needed —at least in terms of the broad alternatives mentioned above.

Certain results of our work already seem indicative. Our greatest surprise to date at Dzibilchaltun has been the increasing evidence that the beginnings of the Florescent Period in Yucatan took place after the abandonment of the southern cities (i.e., after Tepeu times). We mentioned briefly above an architectural-ceramic sequence at Structure 14, and at 57 and 57 (sub) (a smaller structure, razed and buried under the foundations of 57). Each of the three stages of this sequence has been cross-dated securely as *at least* as late as Tepeu 2 in the Peten (Mr. Robert E. Smith was kind enough to make the identifications of the Tepeu 2 Peten trade sherds sealed in these deposits). In view of the radical change in both local pottery and associated architecture within the sequence, we would be inclined to place the final link well beyond the end of this Guatemala subphase. But if still within Tepeu 2, Structure 57 must be placed at its upper limit, about 10.0.0.0.0. in the Maya calendar. Structure 57 is in pure Early Period tradition. Still after 57 and before the Florescent in the Dzibilchaltun stratigraphy comes the period of transition in architectural styles.

Thus, the evolved Florescent in northwestern Yucatan almost certainly appears no earlier than 10.5.0.0.0. and perhaps somewhat later. Clear evidence of architectural transition between the Early and Florescent traditions (at Dzibilchaltun, and equally clearly at Yaxcopoil, only twenty-five miles from Uxmal) speaks strongly against the possibility that this late dating of the Florescent in Northern Yucatan might be explained by time lag, i.e., that the tradition developed earlier in the Puuc area and did not reach the northern area until a much later date. Cultural traditions are indeed subject to delayed diffusion. Evolutionary sequences are *not*.

Equally pertinent to our appraisal of the events which passed in this "blank" zone is the final documentation last season, in this case not unexpected, of a clear period of transition between the Florescent and the Decadent, nicely bridging the gap between the radically different styles of these two periods. In our stratigraphy this directly follows the Modified Florescent, and is directly overlaid by characteristic Decadent material. The characteristic pottery of this period has, as we would expect, already been found lying on the surface above Modified Florescent deposits at Chichen Itza, and at the bottom of the Mayapan trenches, already mixed with the typical redwares of the site.

If the evidence mentioned above is correctly interpreted, our picture of the events which took place within this "blank" zone is considerably altered. The Florescent tradition has been generally considered to overlap the "Guatemala Classic," so that the "blank" zone would only include the final phases of what was called Classic, and the period of Mexican influence at Chichen Itza—which events could well have taken place within the 250 years allowed by the 11.16.0.0.0. correlation. Indeed the 500 years offered by a 12.9.0.0.0. correlation would have seemed excessive.

However, it now looks as if we have much more history to fit into the zone: the entire first phase of the Florescent, the Modified Florescent, and the following period of transition. The 250

years allotted by the 11.16.0.0.0. correlation now seem very little, allowing a rough maximum of 150 for the total life span of the literally scores of major sites in the Puuc area (Uxmal, Labna, Kabah, Sayil, etc.) and a brief period of fifty years apiece for the entire Mexican-inspired architectural sequence of the Modified Florescent at Chichen Itza, and the rise and fall of the black-on-cream ceramic tradition in the following period of transition. Not one of these brief time spans seems sufficient. However, these events could easily be accommodated in the 500 years allowed by a 12.9.0.0.0. correlation.

The Temple of the Seven Dolls at Dzibilchaltun and the nine structures surrounding it, as well as the large terrace on which they were built, have produced very large collections of pottery sealed in and under the architecture and under undisturbed primary floors. The identifiable Peten trade pottery examined by Mr. Robert E. Smith has been of Tepeu 1 age—no Tzakol material, nothing in Tepeu 2 or later. Preliminary examination of the local pottery confirms the dating of the entire complex in Tepeu 1 times—at the start of the second phase of the Early Period. In fact this area of the site does not seem to have been significantly inhabited prior to this time, as the refuse re-used in construction of the group has yielded none of the occasional Tzakol and Formative material almost invariably found in excavations elsewhere.

Two radiocarbon dates from a very well-preserved lintel in the Temple of the Seven Dolls have yielded the date A.D. 475 ± 140 years. It should be noted that this date falls at approximately the border of Tzakol 2 and 3 according to the Thompson-Goodman correlation, at the border of Tepeu 1 and 2 according to the Spinden correlation. As we have seen above, the latter is much more satisfactory. However, using the full 140 years 2-sigma variation, the date could still fall just inside Tepeu 1 according to 11.16.0.0.0. So this pair of dates is at very best indicative.

The same is true of the information in this section in general. The scheme of things that is working out at Dzibilchaltun seems to fit in better with the pattern of a 12.9.0.0.0. correlation than it does with a later one. But the evidence to date is not regarded by us as sufficient to reject a solution at 11.16.0.0.0. We have reason to hope that, once our stratigraphic collections, which have thus far received only preliminary examination, are properly studied, more specific and possibly definitive answers will be forthcoming.

FUTURE WORK AT DZIBILCHALTUN

As in previous seasons, our future work will have the principal goal of obtaining a secure stratigraphic column for the total occupation of the site. This year, and in two planned future seasons, we shall move backward through the first phase of the Early Period and on into the Formative. In the first few days of the current season we were able to locate rich, stratified deposits of basal-flange horizon covering heavy deposits of late formative (Chicanel). Other excavations seem already to have isolated at least one and possibly two distinctive groups of wares, presumably earlier than the Chicanel-like material just mentioned. So we have good reason to believe that our predictions made on the basis of surface material will bear fruit and that the column which now covers the span from post-conquest back to the first phase of the Early Period can be securely continued back into at least three prior periods of occupation. Although the history of this era is virtually unknown in Yucatan, we will be greatly assisted by the detailed and productive stratigraphic studies of the time which have been carried out in the Guatemala lowlands and adjacent regions.

ENVIRONMENT AND CULTURE IN SOUTHERN RHODESIA

A Study in the "Personality" of a Land-locked Country

ROGER SUMMERS

Curator and Keeper of Antiquities, National Museum of Southern Rhodesia, Bulawayo

1. INTRODUCTION

STUDIES in the interrelation between environment and culture were started independently in Germany and England before World War I, by Schilz in 1906 and Crawford in 1910, but these remained on a limited scale for some time and it was not until 1932 when the first edition of Fox's *Personality of Britain* appeared that the effect of the fossil environment of a whole geographical unit on its early inhabitants was first considered.

Fox's study dealt with a comparatively small and simple geographical unit, rigidly defined by the sea, where prehistoric studies had been undertaken for many years and were well documented. It is not surprising, therefore, that a fairly clear "personality" of the British Isles emerged as a result of Fox's brilliant analysis or that he was able to show, with increasing clarity as the book passed through three more editions, that this "personality" had impressed itself on the inhabitants of those islands.

The corresponding problems in a continental mass are far more complex but Childe in the first edition of *The Danube in Prehistory* (1929) brought to the attention of the English-speaking world the importance of geological factors on early food-producing cultures and he developed this aspect in many subsequent publications. Zeuner has for the past twenty-five years repeatedly drawn the attention of innumerable students to the importance of the problem of environment as a whole.

Hitherto, however, these studies have been restricted to parts of the Eurasian landmass and few attempts have been made to apply them to any part of Africa. In 1955 Clark took the first steps in this direction (Clark, 1957) by applying principles of environmental archaeology to the Stone Age cultures of Northern Rhodesia. Owing to lack of evidence, however, Clark was unable to connect his studies with recent and Iron Age and modern historical cultures.

Some years ago the present writer took some limited steps in this direction (Summers, 1950; 1957), but now, having a far greater volume of information about cultures of all ages in Southern Rhodesia, this essay is an attempt to review the effect of the environment of a large area of continental Africa [1] on its inhabitants from Palaeolithic times up to the present.

2. EVIDENCE AVAILABLE

a. GEOGRAPHICAL FACTORS (fig. 2.)

The area involved lies between the Zambezi and Limpopo valleys (both inclusive) and between the Mozambique plain and the semi-desert area of Bechuanaland (fig. 1). It is rather larger than the political area covered by the colony of Southern Rhodesia, but it forms a convenient geographical unit.

Within this area are few clearly marked geographical features apart from the mountain mass where peaks rise to over 8,000 feet (Inyangani 8,517 feet) on its eastern side; this is part of the crumpled edge of the African plateau, which forms an interrupted chain of mountains from the Drakensburg in Cape Province (South Africa) to the Ethiopian highlands.

The main watershed, dividing the Zambezi and Limpopo basins, runs from southwest to northeast and widens from a narrow ridge in the west to a broad plateau in the east which adjoins the eastern mountain mass. The watershed is between 4,500 and 5,000 feet high and the floors of the main valleys 2,000 to 3,000 feet lower. In the extreme west of the area the drainage is to an inland area (Makarikari Pan), while in the east the Sabi River drains directly into the Indian Ocean instead of running into the Limpopo as do most of the south-flowing rivers.

The main direction of the tributary valleys is from south-southeast to north-northwest, but there are important exceptions to this general rule.

[1] Southern Rhodesia is about the same size as Spain or the State of California.

The gradient southward is considerably sharper than that northward.

b. PRESENT CLIMATE AND VEGETATION

The area receives summer rainfall (November–March), borne by winds from a northerly direction. In the winter (May–September) the wind varies between east and southeast and what little moisture it contains is shed on the eastern mountains or on some of the hills on the southern edge of the Mashonaland plateau. Figure 3 shows the present distribution of rainfall.

It is, however, necessary to add that rainfall is by no means consistent. The Bulawayo rainfall for 1956/7 was 21.47 inches, for 1955/6 it

FIG. 1. Central and Southern Africa.

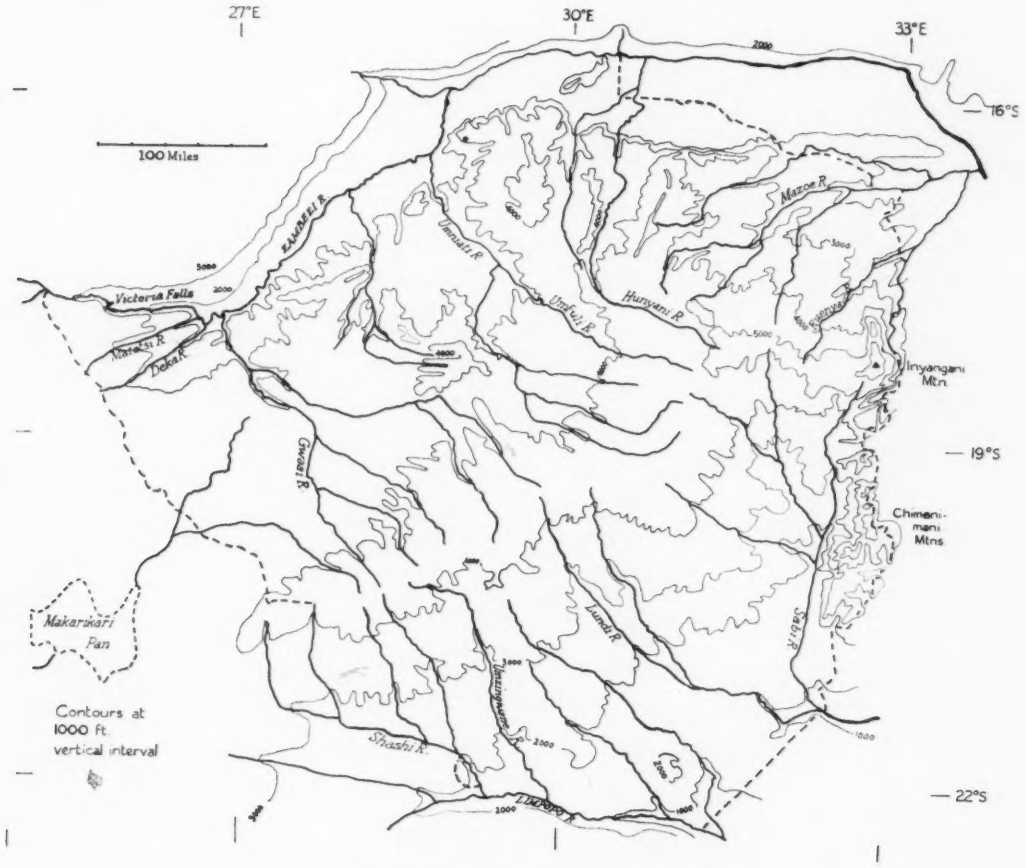


FIG. 2. Physical map of Southern Rhodesia (simplified).

FIG. 3. Present day rainfall distribution (simplified).

was 18.72 inches, in the preceding season it was 39.63 inches and in the next earlier one 19.57 inches (average 1896–1958: 22.27 inches, highest (1924/5) 40.49 inches, lowest (1946/7) 7.85 inches). This is a fairly typical example and can be paralleled from all parts of the area and over the whole of the sixty-year period, during which accurate rainfall records have been kept.[2]

Two points are, therefore, obvious. Firstly, a comparatively small change in rainfall intensity will have a considerable effect on the geological record, giving results comparable to those of a "pluvial" period in areas of heavier average rainfall. Secondly, a more consistent rainfall would have a much greater effect on the vegetation than would a moderate increase in average annual rainfall of the present variable consistency.

The present vegetation distribution is shown on figure 4.[3]

The chief vegetation types are:

(i) Mountain forest—close forest with tall trees having an evergreen canopy and comparatively little undergrowth. It is now restricted to the eastern mountains and has been largely destroyed by man.

[2] I am greatly obliged to Mr. C. B. Archer, Meteorological Officer at Bulawayo for this information.

[3] Slightly simplified from Henkel (1930) with some minor modifications. For advice on this and all other vegetation maps I am greatly indebted to Dr. H. Wild, Senior Government Botanist.

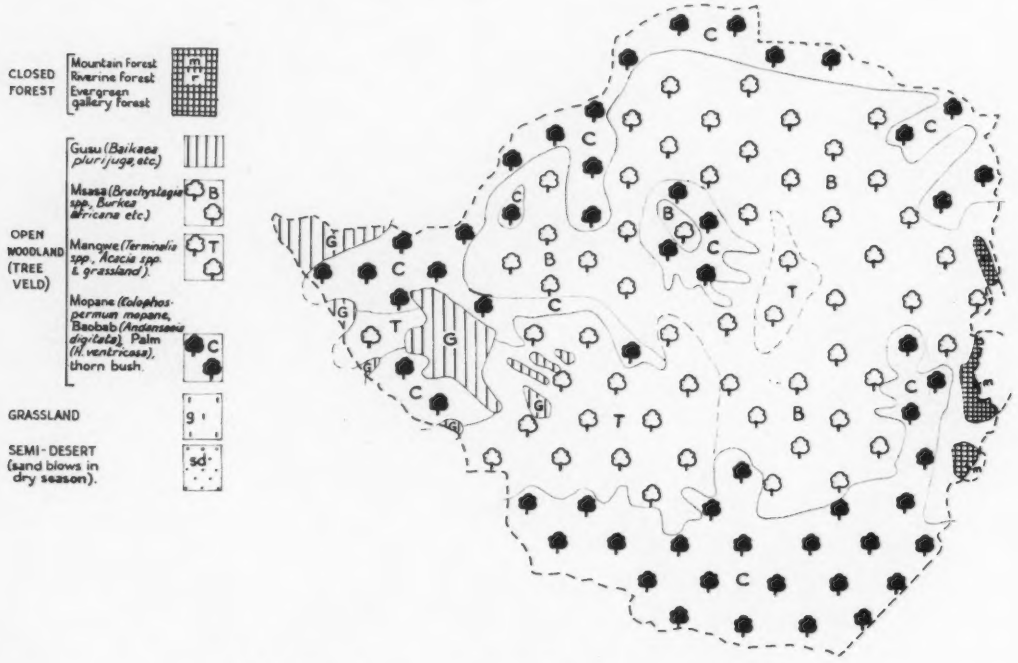

CLOSED FOREST
Mountain Forest
Riverine Forest
Evergreen gallery forest
OPEN WOODLAND (TREE VELD)
Gusu (Baikaea plurijuga, etc.)
Msasa (Brachystegia spp., Burkea africana etc.)
Mangwe (Terminalia spp., Acacia spp. & grassland).
Mopane (Colophospermum mopane, Baobab (Andansonia digitata), Palm (H. ventricosa), thorn bush.
GRASSLAND
SEMI-DESERT (sand blows in dry season).

FIG. 4. Modern vegetation pattern (simplified from Henkel, 1930).

(ii) Hardwood forest (Gusu)—a close forest of tropical hardwoods which flourishes on Kalahari sand areas underlain by impermeable rocks; underground water is, therefore, available to the root systems.

(iii) *Brachystegia* woodland (Msasa and Mfuti)—an open woodland or tropical savannah which covers all areas where rainfall exceeds 25–30 inches. The tree cover varies locally according to rainfall and soil, but generally speaking it is no more difficult to penetrate than temperate woodland. The trees usually have fine foliage which permits the passage of sunlight.

(iv) *Acacia* and *Terminalia* woodland (Mangwe)—open woodland in lower rainfall areas. This is bush country with a considerable amount of space between the trees, which are usually comparatively low. Grasses flourish in this type of country and are usually better grazing than in *Brachystegia* woodland.

(v) *Copaifera* woodland (Mopane)—open woodland in lowlands and in areas with less than 20 inches rainfall. Grass is generally poor but browsing is good. This country is very easily penetrated and used to contain large quantities of antelope and other buck, as well as larger game; it is, however, often suitable for the breeding of tsetse flies.

c. GEOLOGY AND GEOMORPHOLOGY

In detail the geology is complicated, but basically the area consists of an uplifted mass of pre-Cambrian granites in which remain islands of unchanged older sedimentary rocks of the local "Basement Complex." These are usually highly mineralized. Intruded into the granites are dykes of later dolerites.

This mass appears to have been warped at a very early date along the line now occupied by the main watershed and in the main has been a land surface since pre-Cambrian times; the river pattern is therefore a very old one and in general has not changed since Karroo (Permo-Carboniferous) times. There are, however, a number of minor alterations and one major one. The latter is the probable capture of the waters of the Upper Zambezi by another river whose headwaters are represented today by the Deka and Matetsi Rivers (Wellington, 1955: 470–471).

Both north and south of the watershed there are wide expanses of Karroo lacustrine deposits consisting mainly of sandstones and shales. On the western edge is a large area of Tertiary (probably late) aeolian sand. This is the Kalahari sand and in our area is a northeasterly extension of the Kalahari desert. There are remnants of Kalahari sand right across the area and it evidently had a much wider extent in earlier times. From a vegetation point of view the "Great Dyke" running north-northeast across the center of the whole area is important, but it is so narrow an area that its effect on environment is negligible.

TABLE 1

CORRELATION OF PLEISTOCENE DEPOSITS

Zambezi Valley-Victoria Falls (Clark, 1950)	Watershed-Lochard etc. (Bond, 1946, 1949)	Zambezi Valley-Kariba area (Bond, 1959)	Period of increased rainfall
Sand banks		Silts	Present
			Z
		Alluvium IV	
			Y
	Alluvium II*b*	III	
Younger Gravels			X
	II*a*	II	
Redeposited Kalahari sand			
Rubble bed			W
	I	I	
			V
Older Gravels			
			U

d. QUATERNARY GEOLOGY AND CLIMATES OF THE PAST

Pleistocene deposits are unfortunately rather scanty and received little attention before 1945, Bond being even now the only considerable worker in this field (1946, 1957 *a* and *b*, 1959 and unpublished thesis, 1949). H. B. S. Cooke (Cooke and Clark, 1939) and Dixey (in Clark, 1950) have worked on Zambezi gravels in the Victoria Falls area.

The gravels of the Zambezi and northward flowing rivers (especially of the Gwaai River system) show a series of older and younger gravels and still younger alluvimus, but on the Limpopo side of the watershed alluvial deposits seem to be largely missing, possibly owing to the steeper gradient on this side (Bond, 1949). The alluvial deposits of the Limpopo itself have not yet been examined.

Despite the general lack of interest in this period, Bond (1946, 1949, 1957, 1959) has accumulated enough evidence from the Bulawayo area, from the Zambezi itself and from the Kalahari sands to be able to construct a valid sequence

of alluvial deposits, into which Palaeolithic cultures have been fitted by Jones, Clark, and C. K. Cooke.

It is possible to correlate these various sequences on stratigraphical grounds and the correlation is most fortunately confirmed by archaeological evidence (see section 2 (*f*) following).

Table 1 gives an attempted correlation and suggests a series of six "periods of increased rainfall." The nomenclature for these periods is a most awkward problem and as a temporary expedient an alphabetical one is used here to avoid such terms as "First," "Second," "Third," which have already been found wanting, or the East African nomenclature, which is no longer regarded as of continent-wide application (Resolution 1 of 3rd Pan-African Congress on Prehistory).

The intensity of rainfall in the various Periods U to Z has varied widely. The pebbles comprising the Older Gravels are far larger than those of the Younger Gravels, possibly implying a far greater carrying power in the Zambezi in Period U than in Periods W and X. An approximation to the rainfall on the western watershed for Period X has been obtained by Bond by measuring feldspar grains collected from various levels in a section at Khami on the watershed (1957) and a value of about 140 per cent of the present average rainfall was obtained. Although Bond's method has received Flint's approval (1959: 359), it is unfortunate that one site only has been considered so far.

The climatic and floristic implications are discussed in Section 3.

FIG. 5. Developed areas and archaeological exploration.

e. PRESENT DEVELOPMENT AND ARCHAEOLOGICAL EXPLORATION (FIG. 5)

The most fully developed areas in the country lie on the watershed and Mashonaland plateau. In these areas there are large areas under cultivation for food crops and tobacco so that archaeologically these areas are reasonably well known as a result of observation by farmers. All the mineral belts have been intensively prospected and a considerable amount of archaeological information, especially on prehistoric mining, has come from prospectors, mining engineers and geologists.

Country below 3,000 feet has generally speaking been far less extensively developed and here there is rather less archaeological information available. District Commissioners and missionaries do, however, collect information and it is in these areas that extensive professional archaeology is possible.

The only virtually unknown areas are those infested with tsetse fly or kept as game parks and consequently almost uninhabited. Although a certain amount of work has been done in these areas, their existence must never be overlooked in interpreting distribution maps. Limited reconnaissance suggests that the unexplored area in the north may be of archaeological importance, but that the western and southern unexplored areas are negligible archaeologically.

Publication of archaeological information has lagged far behind exploration but, owing to the work of the Historical Monuments Commission and the National Museum in Bulawayo, adequate documentation now exists on an index kept in Bulawayo (Summers and Cooke, 1959).

f. ARCHAEOLOGICAL RECORD

The evidence for the Stone Age record is given in a variety of papers, but has been summarized by Jones (1948) and Clark (1950, 1959*a*) and has recently been added to by Cooke (1957). The post-Stone Age record has been summarized by Summers (1950).

The full record as known in 1959 is given in table 2 and the correlations, worked out mainly by Clark and by Bond, to Periods U–Z of table 1, are also given (for details see page 271).

The distribution of sites by periods is shown on a number of maps which follow, but it is advisable here to give some indication of the extent of the evidence on which the maps are constructed (for fuller details see Summers and Cooke, 1959).

Iron Age D—143 sites recorded but most information comes from written sources.

Iron Age C—Many thousands of sites in an area of about 3,000 sq. miles (Summers, 1958*a*) (about 80 excavations).

Iron Age B—329 sites (about 80 excavated).

Iron Age A—159 occupation sites (about 20 excavated), 305 known "ancient workings."

Later Stone Age—127 known occupation sites (about 40 excavated). The division into periods is stratigraphically recognizable at one site only (Cooke, 1957), typological divisions have long been recognized. 1,100 painted caves of this period.

Magosian—35 known sites (3 excavated). Owing to the difficulty of recognizing Magosian in small assemblages it is probable that some sites recorded as Rhodesian Still Bay are in fact Magosian.

Middle Stone Age—166 sites (about 20 excavated). It is often impossible to differentiate between proto Still Bay and true Still Bay and in many instances both occur in stratified sequence on one site. Both are included here.

Sangoan—90 sites (about 12 excavated). The majority of Southern Rhodesian sites contain Bembesi variant.

Earlier Stone Age (Chelles-Acheul)—57 sites (a few excavations). About one-third of these contain Chelles-Acheul material *in situ*.

(Pebble Culture)—7 sites (1 excavation). Pebble *tools* appear widely but only undoubted pre-Chelles-Acheul material is included here.

Our conclusions are therefore based on evidence from nearly 3,000 prehistoric sites within the political boundaries of Southern Rhodesia as well as that from a further 250 sites in adjoining countries (about 10 per cent have been excavated).

g. EVIDENCE FOR CULTURAL-CLIMATIC CORRELATION

(i) There is no evidence at present for the number of wetter periods between pre-Chelles-Acheul Pebble Culture and the rather late Rhodesian Acheulean which occurs on the next lower bench at Lydiate (Jones and Bond, 1948), but as Clark (1950) finds Chellean and early Acheulean rolled in Older Gravels I at the Victoria Falls and also finds rolled Middle Acheulean and rolled and fresh late Acheulean in Older Gravels II, he has postulated two peaks in what he calls "the Second Pluvial." We may therefore assume at least two wet periods between pre-Chelles-Acheul and late Acheul (Periods U and V).

TABLE 2

ARCHAEOLOGICAL RECORD

Age	Culture			Period of increased rainfall
	Historical (post 1890 A.D.)			
Iron	Rhod. Iron Age D			
	Portuguese occupation			
	Rhod. Iron Age A, B & C			Z
Later Stone Age	Rhod. Iron Age A	Upper	S.R. Wilton	Y
		Middle		
		Lower		
Second Intermed. Stone Age	Rhod. Magosian			
Middle Stone Age	Rhod. Still Bay (local variants)			X
	Rhod. proto Still Bay			
First Intermed. Stone Age	Rhod. Sangoan (local variants)			W
Earlier Stone Age	Chelles-Acheul	Late R. Acheulean		V?
		Middle R. Acheulean		
		Early R. Acheulean		U?
		R. Chellean		
	pre-Chelles-Acheul Pebble Culture			

(ii) The best evidence for the position of the Sangoan in rainfall Period W is to be found in the Zambezi Valley, where a number of sites testify to this correlation (Clark, 1950). Jones (1949) produces equivalent, although less convincing, evidence from the Southern Rhodesia watershed, but many undescribed sites exist and are known to the writer.

(iii) Bond (1957) provides the best evidence for the Rhodesian Still Bay being in wet Period X. Confirmation is inferred from cave sites in Mashonaland and Inyanga by Robinson (1958*a*); this confirmation is the more welcome since Robinson's sites are 400 miles or more away from Bond's.

(iv) A wet period during the Wilton has been suspected for some time (Clark, 1950), but Bond's analysis of rainfall at Khami provides additional evidence. This wetter period (Y) seems, on Bond's evidence, to have been emphasized by the preceding and succeeding "drys," rather than to have been markedly wetter than now. Although there is cave evidence which confirms the existence of wet Period X, nothing comparable has

been found in cave deposits to suggest any later wet period.

(v) Evidence for a wetter period during the Iron Age comes from a number of sites all over the country (Summers, 1958*a*: 258 ff.).

3. PRIMARY DEDUCTIONS

Before passing on to make primary deductions as to past climate and past vegetation distributions, one must remind the reader that, as there are so few quantitative studies, it is inevitable that a good deal of generalization has to be made from localized studies. However, this local quantitative work has frequently been confirmed by field observation (without quantitative analysis) over a very wide area.

a. CLIMATIC VARIATION

The variations in rainfall indicated in the geological record may not be very great ones (see p. 268) and the variation in actual amounts received will vary, so it is better to express the increase as a percentage rather than as an absolute amount. It seems unlikely that the eastern mountains have had much variation in their climate, but elsewhere the variation is measurable or at any rate deducible.

Bond (1957*b*) has already estimated that the rainfall during the Middle Stone Age wetter period (when some erosion occurred) was about 36 inches at Khami, that is to say Period X enjoyed about 140 per cent of present rainfall. The same section showed that subsequent rainfall produced no appreciable erosion in the deposit and it may be deduced that Periods Y and Z were not so wet as X. Examination of the evidence for Period Z (Summers, 1958*a*) suggests that during that time the increased rainfall was more marked in Mashonaland and the east than in Matabeleland; we are, however, entitled to deduce that during Period Z Matabeleland had a more consistent rainfall than now.

TABLE 3

APPROXIMATE INTENSITY OF RAINFALL

Period	Relative intensity	Rainfall factor %
Z	Somewhat wetter and more consistent than at present	120*
Y	Negligible difference	100
X–Y	Appreciably drier than now	80*
X	Estimated in Bond, 1957	140
W–X	Sand moved by wind at times	50*
W	Forest cultures in area	200* or a little less
V	More than X	170–200*
U	More than V, W or X	over 200*

Apart from the Zambesi Valley the evidence for Period Y is shadowy. An alteration in Middle Wilton tools (Cooke, 1957*b*) may indicate some change in life and presumably some change in climate; by itself this would not be sufficient evidence. However, a similar change is noted in Northern Rhodesia (Clark, 1950), so probably Y is a definite climatic phase although maybe only a minor one.

We have already pointed out that the difference in pebble size in Older and Younger Gravels suggests a considerable difference in rainfall [4] and it may therefore be argued that U was considerably wetter than either V, W or X. On the other hand, evidence for the intensity of U and V comes almost entirely from the Zambezi, a river whose headwaters rise outside our area and receive rainfall from a different (tropical) climatic zone. Evidence for V does exist in our area, but in torrent gravels and sandy alluvium. The first give us no clue as to relative intensity, but in the hand Alluvium I (on the watershed) is obviously coarser than Alluvium II*b* (which tends to be sticky and must contain material of clay grade), so even in the absence of any exact measurement we are entitled to assume that the carrying power of streams such as the Chelmer Spruit (Bond and Summers, 1954) in Period V was higher than in X.

For Period W we have not only the evidence of Alluvium II*a* on the watershed—a material seemingly as coarse as Alluvium I—but this period is undeniably correlated to the appearance of Sangoan cultures in our area. These assemblages contain robust tools usually found in the Congo forests and it is only during Period W that they make a brief appearance here (see Sect. 4*c*). We are, therefore, entitled to assume the existence of extensive and continuous forest in Period W, a state of affairs that implies a heavy and consistent rainfall of little less than 50 inches or, say, 200 per cent of present average.

So far we have dealt only with periods of increased rainfall. Periods of decreased rainfall are much more difficult to identify, but one such appears between Periods W and X, when aeolian sands were redistributed during at least part of the year, although no evidence of dune formation has ever been found (Bond, 1957*a*; Clark, 1950).

[4] For an argument on this point—in relation to feldspar grains—see Bond, 1957b.

This implies extensive grassland areas drier than the western part of our area today, and therefore about 50 per cent of present rainfall.

Of other intermediate periods, there is wind-blown sand overlying the Magosian at the Victoria Falls (Bond, 1957*a*), while the Khami Section also suggests that Period X–Y was appreciably drier than at present.

We can now summarize our deductions in tabular form and try to convert our guesses into figures.

The items marked with asterisks are, of course, mere approximations: the absolute values of U, V, and W depend on the correctness of X (estimated on one site only) and so to a lesser extent

FIG. 6. Distribution map—Earlier Stone Age.

does Z. Their relative values, however, rest on evidence from sites all over the country.

By themselves these rainfall factors have no more than an academic interest, yet when applied to redraw the isohyetals of a rainfall distribution and when these are in turn applied to restate the vegetation of the area, the factors become a vital element in the understanding of the prehistory and "personality" of the area.

b. VEGETATION PATTERNS IN THE PAST

The construction of vegetation patterns for rainfall factors of 50, 75, 150, and 200 per cent of present rainfall (figs. 9, 12, 10, 7) was achieved by first redrawing the rainfall map and then amending the present vegetation map (fig. 4) to conform. This implies that the form of the rainfall

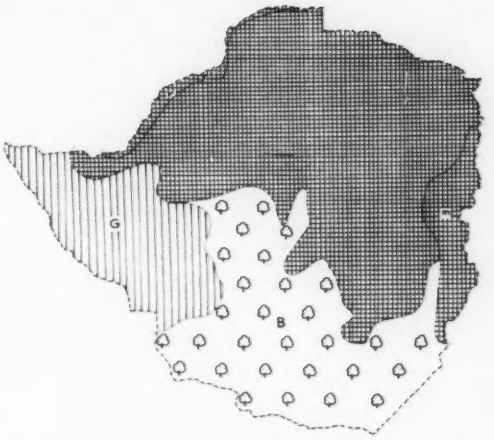


FIG. 7. Reconstructed vegetation pattern—200 per cent of present rainfall.

pattern did not change, which in turn assumes that the basic meteorological elements remained unaltered. This is pure assumption but, so far as weather arising from south of the Tropic of Capricorn is concerned, it seems fairly reasonable (see Wellington, 1955: ch. 7, *passim*). When we have to consider weather arising in the equatorial area, we are on far less secure ground: the East African pluvials alone show that there has been considerable fluctuation in equatorial weather during the Pleistocene, while from our area there is evidence of increased northerly wind during winter months

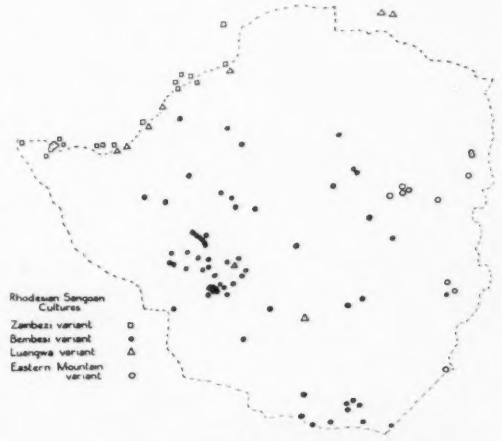


FIG. 8. Distribution map—Rhodesian Sangoan cultures.

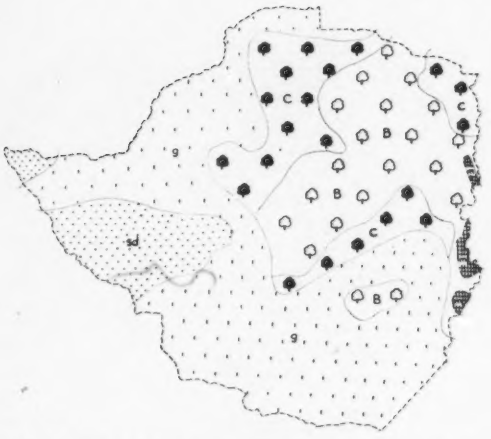


FIG. 9. Reconstructed vegetation pattern—50 per cent of present rainfall.

in the Kalahari sand period—our W–X (Bond, 1949, for Southern Rhodesia; Poldervaart, 1957, for Bechuanaland Protectorate).

We must not, therefore, press our study too far, especially in the earlier periods. From the First Intermediate Stone Age—Sangoan cultures in our Period W—onwards, however, we have a good deal of evidence of all kinds—cultural, climatological, and faunal—and we are on far surer ground. Consequently, our Earlier Stone Age studies here will be extremely tentative.

The Kalahari sand area in the west is a complicating factor. Originally this sand was of much greater extent than it is now and consequently hardwood (Gusu) forest was differently distributed. The effect of this is important in Period W, but in later periods it becomes of academic interest only.

4. INTERPRETATION OF STONE AGE CULTURAL PATTERNS

a. EARLIER STONE AGE (PEBBLE CULTURES)

7 sites (fig. 6).

Owing to paucity of evidence it does not seem possible to draw any conclusions whatever.

b. EARLIER STONE AGE (CHELLES-ACHEUL CULTURES)

57 sites. Periods U and V (fig. 6).

Here too evidence is scanty and, moreover, the period covered is so long that there are at least two wet periods comprehended in it.

There is, however, a contrast between the watershed and the Zambezi Valley which is of some significance for us.

If the various subdivisions of the Chelles-Acheul were to be plotted separately, the watershed would show an absolute blank until the very latest Acheulean, whereas in the Zambezi Valley—especially in the well-explored Victoria Falls area—both Chellean and early Acheulean occurrences appear as well as later Handaxe cultures.

The distribution of Earlier Stone Age cultures in the Zambezi Valley has been studied by Clark (1957 and unpublished work on Kariba Lake area), so they need not to be considered here. The watershed group falls into one unit typologically, all material belonging to the final Acheulean (= Vaal Stellenbosch V; Sohnge, Visser and Lowe, 1937) which some prehistorians in South Africa, with far more material to work on than we have, are beginning to assign to the Fauresmith culture. This culture has always been considered to belong to more or less open country and, being at the very end of the Acheulean, this particular group of sites comes in the interval V-W when one may expect that conditions were not very different from now with grassland or woodland on the watershed (see fig. 4).

For the earlier part of the immensely long Chelles-Acheul culture, therefore, we have too little evidence from our country to draw on, but it is reasonably clear that in the final Acheulean there was occupation in the watershed area. About 50 sites are known but undoubtedly there are

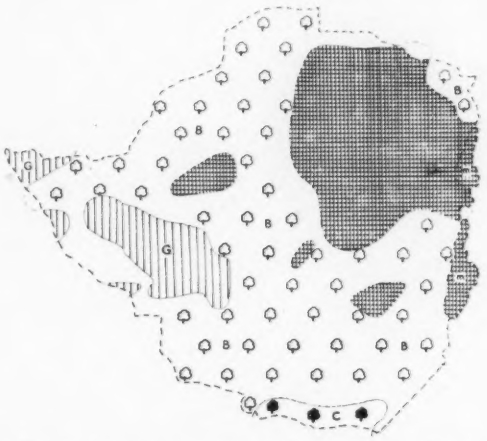


FIG. 10. Reconstructed vegetation pattern—130–150 per cent of present rainfall.

others; this points to the occupation being moderately dense for this period, although sparse in the extreme when compared with later populations.

Until chronological data are available, we cannot say whether our Acheulean is derived from that of South Africa; there is no doubt that the two areas were linked in final Acheulean times, for there are such close typological connections, but beyond that we cannot go.

c. FIRST INTERMEDIATE STONE AGE (SANGOAN CULTURES)

90 sites in Southern Rhodesia, (about 20 just over the borders); Period W (figs. 7 and 8).

Sangoan assemblages contain the following tool types: handaxes; tranchets, cleavers and scrapers of various types; picks; all are roughly worked but there is a great deal of flat flaking suggesting the use of a cylindrical baton in trimming handaxes and other large tools.

The first tool type is a continuation of the Acheulean tradition of what is thought to have been a general purpose tool; the second group are all suitable for woodworking and the third could have been used for digging (Breuil and others call it a "mining tool"—Cole, 1954: 180). We have therefore the beginnings of specialization (observable in the earlier Sangoan industries in the Congo Forest further north), some tools being useful for woodworking and some for digging.

The design of tools, the continuum with the Congo Forest cultures (also known under the blanket name of Sangoan), and the extension of forests all combine to indicate a southward expansion of Sangoan cultures into the Southern Rhodesian forests. Beyond this it was difficult to go—although Sangoan types are found in Natal and Namaqualand (Clark, 1950: 95; Davies, 1951 and 1957). The forest edge formed the boundary between those using Sangoan tools and the contemporary people who practiced the Fauresmith cultures and who lived outside our area. Clark (1950) divided the Sangoan into three variants, to which he later added a fourth (1957). The classification is a typological one and accordingly Southern Rhodesian workers have felt some difficulty in accepting it (Summers and Cooke, 1959), especially as Bond (1948) has shown that Sangoan typology was far more influenced by raw material than was Acheulean. Workers with a wider knowledge of these cultures (e.g., Drs. J. Desmond Clark [5] and O. Davies [5]) have persisted in their view that the Bembesi variant, for example, is appreciably different from the Zambezi one and more recently Dom Adalbert Anciaux de Faveaux [5] has pointed out that our "classic" Bembesi sites contain mixed Sangoan and Middle Stone Age assemblages.

In the light of these criticisms, I have plotted the various Rhodesian Sangoan variants (fig. 8) and, although a number of anomalies are present, this distribution tends to follow the vegetation pattern given in figure 7. It would seem that Zambezi, Luangwa, and Eastern Mountain variants tend to belong to dense forest, and to cluster along rivers, whereas the Bembesi variant appears to belong more to the less dense wooded areas.[6]

Within the forest some areas were apparently more favored than others, Gusu forest being especially popular.[7] A possible reason for this is that, whereas in open forest game could move fairly freely in all directions, in closed hardwood (Gusu) forest game would be forced to use regular tracks and so be more easily trapped.

The concentration of Sangoan sites in the Zambezi Valley is worth noting here. It provides useful evidence of the value of rivers in penetrating heavily wooded country (Clark, 1957).

d. PERIODS W–X (FIG. 9)

This is the only dry period about which we have any good climatic evidence and unfortunately we have no archaeological information which can be assigned at all definitely to it.

Figure 9 shows the vegetation pattern which certainly makes clear why it is that Sangoan material at the Victoria Falls and in the Gusu sites has been covered up with drift sand and also why the sand contains little cultural material. Dom Adalbert Anciaux has recently pointed out to me that the windblown sand on some of the Gusu sites does in fact contain implements of rough Middle Stone Age type. The matter urgently requires fuller investigation, but at first glance it would appear that

[5] Personal communications.

[6] It is worth mentioning that the late Professor C. van Riet Lowe, on examining a Bembesi assemblage in 1949, pointed out the resemblance of some of its constitue..ts to the Fauresmith—a contemporary open country culture.

[7] Owing to its small scale the map cannot show the very dense concentration of sites in these areas. Along the Bulawayo-Victoria Falls Road, there is a stretch of about ten miles where one can find a good Sangoan assemblage in any road metal pit that happens to be open; frequently the gravel verges of the road are covered with Sangoan artifacts (see Jones, 1938).

FIG. 11. Distribution map—Rhodesian Still Bay cultures.

early Middle Stone Age hunters penetrated the grasslands during Periods W–X, just as they went into the grasslands further west in Period X itself (see Bond and Summers, 1954).

In the east of the country where there was still some tree cover we find Rhodesian Sangoan of a facies typologically similar to Clark's Luangwa Variant and which he assigns to this period. Unfortunately, all our sites are surface ones and we cannot be sure whether the sites in the eastern districts belong to Period W or W–X.

c. MIDDLE STONE AGE (RHODESIAN STILL BAY CULTURES)

166 sites in Southern Rhodesia; Period X (figs. 10, 11).

It is impossible to distinguish on our map (fig. 11) between the Rhodesian proto Still Bay and the Rhodesian Still Bay. In many cases they occur in stratified sequence on the same site. This undoubtedly indicates a long period of occupation of each site—usually in a cave or rock shelter—and possibly betokens a long period of increased rainfall. Bond (1957*b*) notices two rainfall maxima, one of which was a major one, so our climatological and archaeological evidence reinforce each other.

The rainfall at this period seems to have been more consistent than it is now, and rains of about the same intensity as those we now experience in "really wet" seasons fell with monotonous regularity. In such circumstances summers would be cooler and winters appreciably wetter than now. The use of caves as homes is readily understandable. Some sort of clothing may also be postulated and the profusion of small scrapers, backed blades and piercers, which appear for the first time in Middle Stone Age assemblages, may perhaps be interpreted as tools for making up skins into blankets and similar coverings.

A typical Rhodesian Still Bay assemblage consists of a considerable number of points—which grow smaller in size as the culture progresses—a smaller number of backed blades, large crescents, and other tools adapted for cutting, and a much larger number of scraping tools. Boring tools occur but are infrequent and burins occur mainly in the upper levels. Disc and tortoise cores—which also reduce in size as the culture progresses—are extremely common. During the proto Still Bay culture nonlocal raw materials begin to occur and this tendency increases greatly in the Still Bay culture (Cooke, 1957; see also Armstrong, 1931; Jones, 1940).

Thus we see that the Middle Stone Age was a period of hunting, presumably with spears armed with stone points, and so it is not unreasonable to find all the known sites concentrated in woodland and especially in forest (Fig. 10). With widespread woodland (not mere bushveld), hunting opportunities were good and the very wide scatter of Middle Stone Age artifacts[8] shows that the hunters traveled far and wide.

The vegetation map (fig. 10) has been drawn as an average distribution during this period. At the rainfall maximum—over 150 per cent of present—the Mopane areas in the Limpopo and Sabi Valleys would disappear, so there is nothing anomalous in finding Middle Stone Age artifacts in areas now covered by Mopane bush.

The ancestry of the Southern Rhodesian Middle Stone Age cultures is not clear. Typologically they are nearly as closely related to the Kenya Still Bay as they are to the Northern Rhodesian Still Bay, a fact which might suggest a common origin and collateral development for the Middle Stone Age cultures north and south of the Zambezi.

Coupled with the distribution map (fig. 11) the typological evidence suggests the diffusion of Middle Stone Age ideas from East Africa and both

[8] Middle Stone Age flakes are the commonest of all surface finds in Southern Rhodesia. Often they are collected in ones and twos and such finds do not rank as "sites." The number of sites given above on this page cannot, therefore, reflect the true position, although the general distribution pattern is adequately shown in fig. 11.

contact and parallel development in the two Rhodesias.

On the other hand, there are such close similarities between the Southern Rhodesian Middle Stone Age and that of South Africa that the very cultural name is common. It is likely that the various South African Middle Stone Age industries arose by a natural development from the Fauresmith (and ultimately from the Chelles-Acheul) cultures, so it is just as likely that our Middle Stone Age is a product of the south and entered our area from the southwest.

The only certain point is that it is not of autochthonous growth owing to the semi-desert phase in Periods W–X.

f. SECOND INTERMEDIATE STONE AGE (MAGOSIAN CULTURE)

35 sites in Southern Rhodesia, (a few just over borders west and south). Periods X–Y (figs. 12, 13).

This falls in the period just after the long wet Period X and is considered by Bond (1957*b*) to have been a little drier than now. The authority quoted rests on a quantitative analysis at one site only. There is, however, a good deal of evidence from sites all over the country that the period was dry—for instance, Magosian sites are nearly always in the open. The vegetation pattern can have been little different from now, except that Mopane woodland was probably more extensive (fig. 12). In such circumstances opportunities for hunting would tend to be found near watering places and it is very noticeable that sites which are definitely known to be Magosian are never more than one quarter mile from a perennial stream. They are usually in light woodland and avoid the Mopane zone as much as possible.

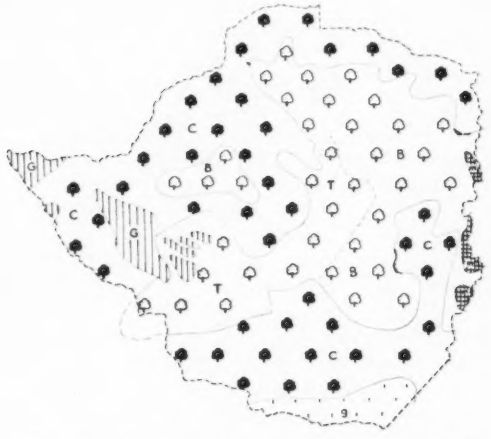


FIG. 12. Reconstructed vegetation pattern—60–75 per cent of present rainfall.

FIG. 13. Distribution map—Rhodesian Magosian culture.

Typical Southern Rhodesian Magosian assemblages contain much that is common in Still Bay assemblages. Tools become even smaller and some are reduced to microlithic dimensions, although usually made by a Middle Stone Age technique. True microliths—made by a modified blade technique—appear for the first time (Cooke, 1957*b*).

After an exhaustive stratigraphical examination of the type site of the Southern Rhodesian Magosian, coupled with typological studies of all the important Magosian assemblages in Southern Africa, Cooke (1950; 1957*b*) has concluded that the bow was introduced during this cultural period. His view has been controverted by various writers, but most authorities consider that the new tool types introduced during this period were for making multiple weapons and a good many interpret these fresh weapon types as projectiles (e.g. Caton-Thompson, 1947). Despite these new ideas, the basic technique continued the tradition which had started in the Earlier Stone Age (van Riet Lowe, 1945).

It is interesting to note that in Northern Rhodesia the Magosian is found in the lightly wooded west (Clark, 1957) and that the Congo forests form an absolute barrier to it (Mortelmans, 1957).

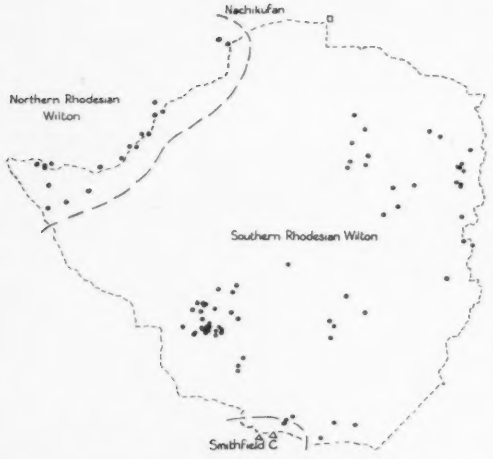


FIG. 14. Distribution map—Later Stone Age.

g. LATER STONE AGE (WILTON CULTURE)

127 industrial sites in Southern Rhodesia, (a few in adjoining parts of Bechuanaland). Period Y (figs. 14, 15, 16).

While Period Y has left no trace in the geological record on the watershed (see p. 272), it is probable that it caused some minor fluctuations in the distribution of Mopane woodland on the flanks of the main watershed, while more consistent rains would mean a considerable increase in tree growth as well as cooler weather (see p. 276). Cave dwelling is therefore likely and, in fact, we find that in many caves Wilton succeeds Middle Stone Age in the cave sequence without any Magosian deposit, its place being taken, especially in Mashonaland caves, by a sterile layer of exfoliated granite (Robinson, 1952; 1958*a*).

During this period all trace of the old Early and Middle Stone Age techniques of stone working disappeared and their place was taken by new ones derived from the blade technique.

Typical Southern Rhodesian Wilton assemblages are almost entirely microlithic. Points are no longer made, but there is a variety of lunates and backed blades which may have been used for arming arrows. Small scrapers (thumb nail) are very common. New tool types also appear, especially the ground stone "axe"; most tools, including the

FIG. 16. Geomorphology of granites.

FIG. 15. Distribution map—rock art.

"bored stone," carry on from the Magosian. These points coupled with an apparent [9] change in physical type suggest a migration of people during the Magosian and Later Stone Age.

The direction of such a migration is not known, but the distribution map (fig. 14) suggests that the Zambezi was a highway, and its tributaries, especially the Mazoe/Ruenya and the Gwaai, provided access to the country.

The absence of Later Stone Age sites on the Umfuli-Umniati system and their paucity in the Limpopo area may at first sight look like lacunae due to insufficient exploration, but if the distribution of another aspect of the Later Stone Age cul-

[9] "Apparent" because there is insufficient skeletal evidence in our area to be dogmatic (but see Tobias, 1958).

tures—rock art—is examined (fig. 15) it will be seen that the same gap appears in a much more completely explored Later Stone Age field. It would seem that for some reason the Umniati and the Limpopo were not greatly favored by Later Stone Age Man.

There is a close typological similarity between Northern Rhodesian Wilton and the Southern Rhodesian Wilton of Bumbuzi (Clark, 1950) and one may conclude that here is a case of a Stone Age culture coming into both the Barotse Plain and the Deka and Matetsi Valleys from some common source, but there are no chronological data in our area which will give any indication of the direction of the movement.

The difference between western (Wilton) and eastern (Nachikufan) facies of the Later Stone Age in Northern Rhodesia is far less clear south of the Zambezi. There seems, however, to be a preponderance of ground stone "axes" and bored stones in the east of our area, just as there is north of the Zambezi. These may be a result of the more heavily wooded area in the east. On the other hand, two Smithfield-like assemblages [10] in the extreme south are especially noteworthy. They are considered rather doubtful Smithfield, but the occurrence of two more Smithfield C sites just south of the Limpopo (Malan & Van Niekerk, 1955) suggests that here we have an extreme northward extension of the Smithfield culture.[11]

h. ROCK PAINTINGS AND CARVINGS

1116 sites in Southern Rhodesia, (about 100 in adjoining parts of Bechuanaland and Transvaal) (figs. 15, 16).

Our knowledge of the distribution of the Later Stone Age peoples is not, however, confined to Wilton and allied assemblages. Rock art also calls for consideration. The very thin Later Stone Age deposits in even the most important caves suggest that these were not continuously occupied and may even have been assembly places occupied only at special seasons.

Rock paintings in Southern Rhodesia (fig. 15) are nearly always painted on smooth granite rock faces sheltered from the weather. Since such places are found in limited areas, a geological map of granites does not give a true idea of the potential distribution. By using morphology as well as geology, however, it has been possible to construct a map of suitable areas (fig. 16).

Rock paintings are by no means uniformally distributed over the areas which are potentially paintable. There is a fairly wide scattering of paintings which are considered on stylistic grounds to be early, but later paintings are concentrated in well-marked groups in northern and central Mashonaland, in the area east of Fort Victoria and in the Matopo hills.

The blank areas between these groups are places which are covered with Mopane veld during drier periods (see figs. 4, 12), so once again it would seem that this type of country was avoided by the Stone Age hunters.

So far as we can tell, no Southern Rhodesian paintings are earlier than Middle Wilton (Cooke, 1959), but this must be accepted with reserve.

Animals depicted in rock art contain no totally extinct species (with the exception of some doubtful examples of quagga), although many no longer exist in the areas where they were drawn. Some show evidence of wetter conditions than now subsist (e.g., hippo and various types of fish in areas where there is no perennial open water; elephant and giraffe where there is no longer suitable feed), whilst others provide possible evidence of slightly drier conditions (e.g., zebra and wildebeeste in country no longer open), but this is not completely conclusive since hunter-artists could have seen the animals they depicted far from the place where the drawing was made.

There is some artistic evidence that animals, whose habitat may have been distant from a given painting, were not so well drawn as local animals (Cooke, 1959), yet many of the examples of locally extinct animals just quoted are very well drawn.

There is no doubt that minor climatic changes could be deduced from a close study of rock-painting fauna.

Rock art in Southern Rhodesia is naturalistic and often reaches a very high artistic standard, being stylistically intermediate between Tanganyika and South African rock art: it differs entirely from that found in Northern Rhodesia and Nyasaland which is a highly stylized and symbolic art (Cooke, 1959; Clark, 1959*b*).

We have already referred to the existence of two cultural provinces—Wilton and Nachikufan—in Northern Rhodesia during the Later Stone Age. The difference between Northern Rhodesian rock art (associated with the Nachikufan) and South-

[10] Not accepted as true Smithfield by prehistorians who are well acquainted with this culture.

[11] Both Goodwin (1929) and Lowe (1929) have pointed out that Smithfield C and Wilton are closely related.

FIG. 17. Distribution map—Iron Age A ceramics.

ern Rhodesian art (associated with the Wilton) is most striking (compare Clark, 1959*b*, with Cooke, 1959) and, although both could have been derived from the same source, neither is ancestral to the other. On the other hand the close similarity of East African industries and art to those of Southern Rhodesia shows that there is likely to have been an intimate connection between the two areas (Summers, 1959).

There are a few rock engravings of the Later Stone Age in our area. One group, in the Deka Valley, appears to belong to the Lower Southern Rhodesian Wilton and so may be earlier than any existing rock painting in the area. A fine naturalistic engraving, in the extreme south, appears to be related to a South African engraving group and may have Smithfield affinities; there are Smithfield-like sites nearby.

The Upper Wilton in Southern Rhodesia was contemporary with the onset of local Iron Age cultures and the same applies both to Upper Wilton and Nachikufu III north of the Zambezi, which from historical evidence can be dated to the first millennium A.D. and on geological evidence to a climate slightly drier than we experience today (Cooke, 1959; Clark, 1959*b*).

i. CONCLUSION

It will be seen that Southern Rhodesian Stone Age cultures, at any rate from the Final Acheulean onwards, conform to vegetational patterns deduced from climatological data.

Thus Sangoan cultures are restricted to forest environments; Middle Stone Age cultures are found in woodland areas; Magosian sites are never far from water and Wilton cultures appear to shun Mopane areas as far as possible.[12]

These bear out Clark's conclusions for Northern Rhodesia (1957), but it now remains for us to examine the position in post Stone Age contexts.

5. INTERPRETATION OF POST STONE AGE CULTURAL PATTERNS

a. IRON AGE A

159 occupation sites (fig. 17).

The earlier part of this period overlaps with that of the Later Stone Age and as this was climatically a continuation of Period Y, it would seem that climatically and floristically things were not then very different from what they are today.

There are a number of sub-divisions of Iron Age A which have so far been classified by their ceramic content. These are:

Channelled Wares	about A.D. 100
Ziwa	A.D. 600–1000 (Summers, 1958*a*)
Gokomere	before A.D. 400 (Robinson, 1960)
Leopard's Kopje etc.	A.D. 900 onwards (Robinson, 1959)
Mapungubwe (NT_1)	A.D. 1000–1700 (Gardner, 1958)
Salisbury Wares	not yet dated

Figure 17 gives the distribution of the various wares and it will be seen that most of the sites fall in the *Brachystegia* and *Acacia* areas. Channelled Ware appears on the map to be confined to the Zambezi Valley, but a glance at figure 5 will show that in this particular instance there is so much unexplored ground that one cannot say that the Channelled Ware people did not penetrate into the Mopane areas. The Mapungubwe culture is certainly found in what is now Mopane area and it demands special consideration.

Period Z occurs after the end of the Ziwa cultures at Inyanga (Summers, 1958*a*; 262),[13] while Mapungubwe was flourishing about A.D. 1050[14] and so falls in wetter Period Z. This period was not apparently marked by a great increase in rainfall in Matabeleland although rains were probably consistently good (p. 272). Under these circumstances Mopane areas would be much reduced, possibly as much as in Period X (see fig. 10), and accordingly the earlier Mapungubwe culture would have flourished in a *Brachystegia* environment.

[12] Large scale maps of the Zambezi and Limpopo Valleys show this far more clearly than is possible on our small scale figures.

[13] The dating for the Ziwa cultures has now been confirmed by a radiocarbon date. Communication from Mr. F. O. Bernhard.

[14] Radiocarbon date for a "beast burial" at Mapungubwe (Gardner, 1958).

The distributions may also be considered from a geographical point of view:

Channelled Wares seem undoubtedly related to the Main Zambezi Valley.

Ziwa Wares occur on or near rivers of the Mazoe-Ruenya system or in areas easily reached from that area.

Leopard's Kopje Wares straddle the western watershed.

Mapungubwe (NT_1)[15] Ware occurs mainly on the Shashi and Umzingwane Rivers and their tributaries.

Gokomere Ware is restricted to southern Mashonaland.

Salisbury Ware occurs in northern Mashonaland.

Typologically Channelled, Bambata, and Gokomere Wares fall together, while Ziwa, Leopard's Kopje and, less obviously, Mapungubwe (NT_1) fall into a slightly different group with Salisbury Ware in a third. Moreover, there is a chronological division but more important than any other consideration is the fact that the Ziwa-Leopard's Kopje-Mapungubwe (NT_1) group is intimately associated with "ancient workings."

We can therefore separate the Iron Age A wares into two groups—an Early and a Later (or Mining) Group.

Early Group

Channelled and Bambata Wares appear on typological grounds to be related to Gumban B Ware in Kenya. Unfortunately there is an archaeologically blank area between Kenya and Rhodesia so the connection remains merely speculative. To connect these two ceramic groups is, however, not impossible chronologically.[16]

One may, therefore, picture the Channelled Ware people coming up the Zambezi, throwing off groups to right and to left. Of the leftward shoots Bambata Ware is perhaps the oldest, although its exact relationship to Channelled Ware is unknown at present. Gokomere, possibly entering Southern Rhodesia by way of the Hunyani Valley, may also have been an early offshoot. Much more work must be done to determine these connections; at present we are still in the exploratory stage.

[15] This ware was originally called Mapungubwe M_5, but was renamed "Northern Transvaal 1," abbreviated to NT_1, by Schofield in 1948.

[16] Gumban B—some centuries after 850 B.C. (Leakey, 1945); Zambezi Channelled—A.D. 100 (C-14 date).

Later (or Mining) Group

Although wares of this group do occur in "ancient workings," they also occur on living sites elsewhere. In all cases that have been excavated and in most of the others it would seem that an easily worked soil, light in texture, was preferred for occupation. This preference is clearly noticeable in areas such as Inyanga, where the soils vary considerably (Summers, 1958*a*), but unfortunately it can only be shown on a large-scale map. One presumes that the Mining Group was unable to work heavy soil—unfortunately none of their agricultural tools has yet been recovered.[17]

b. "ANCIENT WORKINGS" (FIG. 18)

305 sites in Southern Rhodesia, about 50 in Tati District of Bechuanaland.

There were a very large number of these, but nearly all have been destroyed or covered up as a result of modern mine workings. Only about 350 of these workings are recorded but before European mining commenced there must have been several thousand.[18]

Their distribution was of course controlled by both geology and economics, for the miners do not seem to have worked gold ore which is poorer than 2 or 3 ozs. to the ton (although a lot of poorer ore

FIG. 18. Distribution map—Areas of "Ancient Workings."

[17] The analogy of Neolithic, Bronze Age, and earliest Iron Age settlements on loess and on chalky and sandy soils in Europe springs at once to mind.

[18] There were 120 in 50 square miles around Bulawayo. See Mennell and Summers, 1955, where the original number in Southern Rhodesia is estimated at about 7,000.

FIG. 19. Distribution map—Iron Age B ruins. Principal ruins and sites: 1, Mtoko; 2, Matendere; 3, Zimbabwe; 4, Chummungwa; 5, Mapungubwe; 6, Vukwe (B.P.); 7, Khami; 8, Dhlo-Dhlo; 9, Naletale; 10, Ntaba zi ka Mambo; 11, Bumbuzi.

was mined, it was discarded beside the working). Copper oxides and, less frequently, carbonates were mined, but not sulfides.[19]

Although very little pottery has been recovered from the "ancient workings," [20] sufficient is known for us to be sure that the only wares found are Ziwa, Leopard's Kopje, and, occasionally, Mapungubwe (NT_1).

A common interest in mining may therefore be taken to account for the relationships between these ceramic traditions, observed during a study of material from living sites.

Schofield (1948) has pointed out typological similarities between Iron Age A wares (which he called R_1) and those made by various Sotho tribes from the Union of South Africa. As all Sotho groups live either west of the Limpopo River or south of the Zoutpansberg Mountains, connection between Southern Rhodesia and the Sotho areas could only have been southwestward.

These archaeological considerations draw attention to the avoidance of Mopane velt, to the importance of Zambezi and Mazoe/Ruenya Valleys as channels of communication and to the southwesterly route through Bechuanaland, all of which we have already noted at various stages in the Stone Age.

c. IRON AGE B—PERIOD Z

329 sites in Southern Rhodesia, a few in Bechuanaland and Transvaal, some in Mozambique (fig. 19).

Nearly every Iron Age B site known contains the remains of a stone building, but the converse is not true and it is difficult to separate later stone buildings from those of this period. This has, however, been attempted for Mashonaland by using an architectural analysis based on the excavation of some key sites (Whitty, 1959). In the southwest of the country a somewhat similar method has been used by the present writer but no results have been published so far. Stone buildings which certainly belong to Iron Age B are shown in figure 19.

Very nearly all such stone buildings are built either of granite or, infrequently, of quartzite. Naturally, therefore, we find that the distribution of stone ruins is controlled by geological factors. A few sandstone buildings occur, in places where Karroo sandstones are found between blocks of granite country.

Ruined buildings are most heavily concentrated on granites surrounding goldbearing rocks of the pre-Cambrian "Basement Complex," but ruins are also scattered throughout *Brachystegia* and *Acacia* areas. Where Mopane bush covers granites, stone built ruins do not occur.

All Iron Age B ruins are not of equal importance and it has seemed worth while to plot the larger ones with a different symbol. Buildings with decorated walling were presumably more important than those which were undecorated and we have some reason to think that decorated walling is in some way connected with chieftainship (Summers, 1958*b*). All these more important buildings are on fairly high ground and the way in which they cling to *Brachystegia* woodland is remarkable.

It is premature to discuss the avoidance of Mopane areas at this point but this seems all of a piece with the same phenomenon already noticed for Stone Age cultures.

Communications

Stone buildings of Iron Age B are often spoken of as belonging to the "Zimbabwe Culture" and Wieschhoff (1941) has drawn attention to the existence of a complex state organization at that time. Such a system and large and often elaborate

[19] The most productive copper mine in Southern Rhodesia (the Falcon at Umvuma) was worked in prehistoric times for gold only, the copper sulfide ore being unsmeltable by our Iron Age miners.

[20] Most of it went "through the mill" in the days before any interest was taken in Rhodesian archaeology.

buildings imply a period of peaceful conditions over a large area. One might expect, therefore, to find some system of communications throughout the country.

There are, however, no ancient roadways visible on the surface of the ground, no hollow ways or green lanes such as one finds in Europe. Although the absence of wheeled and especially of hooved traffic could account for a lack of such signs, the hard underlying rocks and the ease with which a path becomes a gully after heavy rain must also be taken into account.

Nevertheless, important footpaths must have existed and it seems desirable to make some effort to plot them.

The pattern of Zimbabwe-type buildings disclosed in figure 19 suggests two main lines of communication and, when large and elaborately decorated buildings are combined with the overall distribution, the pattern becomes clearer.

One route would seem to have run roughly southwest from the Mazoe Valley to the Plumtree area, passing through such important sites as Dhlo-Dhlo (8) and Khami (7). The second route is less clear but seems to run from the Ruenya Valley southward to Matendere (2) and then generally westwards through Zimbabwe (3), Chumnungwa (4), and the closely settled Belingwe area to the Tati area of Bechuanaland. Both these routes seem to stop their westward progression about 27½° E. and are joined by a more or less north-south road which passes through Vukwe (6) in Bechuanaland. There were probably cross-routes but details are not yet clear.

Figure 19 also suggests two branch routes, one north and west from Dhlo-Dhlo to Ntaba zi ka Mambo (10) and Bumbuzi (11), whose existence is based on traditional evidence, and another from Chumnungwa to Mapungubwe (5) and westwards, which can be plotted from a consideration of the distribution of M_1[21] pottery.

It should be emphasized that these "routes" have been reconstructed from a consideration of distribution maps and that there is no field evidence for their existence. On the other hand there is a mass of unpublished traditional evidence which tends to confirm the hypothesis of a general system of communications.

All these routes lie above the 2,500 feet contour and most are below the 4,000 feet one. Under present conditions some, especially the southerly branch to Mapungubwe, lie in Mopane areas but all the rest are in *Brachystegia* or *Acacia* woodland. During increased rainfall Period Z (when these cultures flourished) there was a considerable reduction in Mopane areas and nearly all the routes would then have been outside the Mopane belts.

d. IRON AGE C—PERIOD Z

Some thousands of sites on the Inyanga Mountains in Southern Rhodesia and Mozambique.

The Terrace cultures at Inyanga occur in a specialized environment and elsewhere I have suggested that the attacks of cannibalistic "Zimbas" on tribes in the South Nyasa region may have led to a wholesale flight to the mountains south of the Zambezi (Summers, 1958*a*) but, whatever the cause, it was something of a peculiarly terrifying nature for the settlement pattern continued in more favorable lowland country for some centuries, by which time the threat had presumably ceased.

It is interesting to note that here we have an example of Man making a great change in the environment. Tree-cutting was so intense in a restricted area that forest recovery seems to have been extremely slow. In places there is a form of vegetation which appears to be mountain grassland[22] but which is in fact the result of the complete destruction of mountain forest cover.

At Inyanga and the adjoining districts the country has been changed by Iron Age C clearing just as completely as the watershed has been by the modern use of power-driven agricultural machinery.

The "personality" of this area has departed and it is not surprising that a local legend accounts for the barrenness of the Inyanga highlands by saying that because men destroyed the country, *Mwari* (God) destroyed the men.[23]

6. INTERPRETATION OF HISTORICAL COMMUNICATION AND SETTLEMENT PATTERNS

So far we have been considering cultural patterns deduced from archaeological data which,

[21] This is Schofield's original nomenclature. Unfortunately, in his early descriptions the ware which he called M_2 was *older* than that which he called M_1. This led to confusion and accordingly he changed M_2 to NT_1 some ten years after the original publication.

[22] It was so marked on the earlier vegetation maps (Henckel, 1930).

[23] I am indebted to Mr. J. Blake-Thompson for this very apt story told to him by a Shona informant. The Inyanga Terrace-dwellers seem to have been non-Shona people!

though completely objective in themselves, are capable of a variety of interpretations, especially if they are scanty. It is, therefore, most desirable that we should consider other patterns, for which we do not rely on the interpretation of archaeological information but of which we have a written record. We may then test the conclusions drawn from archaeology by the touchstone of historical evidence.

a. ARAB TRADE ROUTES

There are ample Arab records testifying to the importance of the port of Kilwa in southern Tanganyika and it is clear from a late, but apparently accurate, copy of the pre-sixteenth-century *Chronicle of Kilwa* (Gray, 1951/2) that it was that port which controlled the sea route to Sofala.

Kilwa's control arose apparently from the extremely difficult navigation south of the monsoon area. Vessels could easily coast south from Kilwa but, without special knowledge, could not return. Dhows can sail very close to the wind but, being of shallow draught, are very inclined to "crab." Consequently they could not tack up against the 3- or 4-knot south-flowing Mozambique Current. The only way to get back was to fight their way across the Mozambique Channel until they made a landfall on Madagascar, then make use of a north-flowing current to return to Kilwa up the west coast of Madagascar and across via the Comoro Islands (see fig. 1).

When the port of Sofala was first established we do not know. Masudi suggests a tenth-century date but other Arabs give rather later ones. It was undoubtedly flourishing in the fourteenth century.[24]

Once the Beira Sofala was on the map, it was able to deal with the Rhodesian gold trade, for the Manica mines were but 180 miles away.

The richest gold fields were, however, far away in the area between the present Hartley, Gwelo, and Selukwe, and their most obvious outlet was down the line of the Lundi River, a route which would have tapped the other main sources of "ancient" gold, the Bulawayo and Belingwe areas. This route seems to have been used since a number of important ruins of Iron Age B lie along it and recently some evidence has been found for a port on the Sabi River near the Lundi confluence, two hundred miles from the sea but navigable from the estuary.[25]

Both these routes were, however, comparatively late and Kilwa must originally have collected Rhodesian gold by an overland route. The exact route cannot now be identified on the ground for Africa is seamed with footpaths, ancient and modern, but has no ancient highways. Native traditions speak of an old way which followed the Ruenya River, crossed the Zambezi near Tete (one of the earliest Arab trading stations in the interior) and so north and northeast across Mozambique and Tanganyika. So far there is insufficient archaeological evidence to prove this route but much of it was used by nineteenth-century slavers and it is interesting to note that, although that aspect of the slave trade did not touch our area, beads commonly used in the trade have been found in Southern Rhodesia only along that route.

Kilwa's own hinterland of Southern Tanganyika produces no gold but in 1502 Vasco da Gama collected as Kilwa's tribute to the King of Portugal 1500 miticals of gold (about 250 ozs).[26] It seems more than likely that this was Rhodesian gold.

b. PORTUGUESE EXPLORATION AND OCCUPATION (1512–1700)

The Portuguese seized the Arab coastal trade between 1502 and 1510 and thereafter commenced to explore inland.

The first recorded exploration was made by a lone Portuguese, Antonio Fernandes, in 1512–1514. He recorded only the names of the chiefs and whether gold or food could be obtained. From this information various routes have been deduced (Tracey, 1940; Godlonton, 1945; Schofield, 1949),

[24] As "Sofala" is a mere geographical term, meaning "a shoal," it is difficult to know whether Masudi is referring to the Beira site or to some other.

[25] Unpublished information from Mr. J. Blake-Thompson (1957): (*a*) A long artificial lake now partly silted but originally running in from the Sabi: it was concealed from all enquirers and protected by a strong "tabu." It would therefore appear to be both old and probably of exotic origin. I have seen this place and am convinced it is artificial. Native African informants tell of eight other such sites on the Sabi (Save) River. (*b*) The presence of estuarine turtles and marine fishes at the Sabi-Lundi confluence shows that the river is, or could be, navigable from the mouth to this point. (Estuarine fish were collected here by an expedition from the National Museum of Southern Rhodesia in 1958.) (*c*) There are persistent native legends which seem to point to the same end.

[26] This was made into a monstrance for the service of the Monastary of Belem. It is now in the Museu de Arte Antiga, Lisbon (*Illustrated London News*, 28 January, 1956).

FIG. 20. Distribution map—Portuguese ruins and relics and probable tribal distribution in sixteenth century.

but in view of their wide differences some must be wrong. Godlonton's seems to provide the best fit, but even so there seem some anomalies. Figure 20 gives the probable position of chieftainships mentioned by Fernandes.[27]

Fernandes started from Sofala but, apart from Homem's expedition about 1574, the direct route does not seem to have been used owing, apparently, to Manyika hostility. The most usual Portuguese route, which lasted until the beginning of the eighteenth century, was by boat up the Zambezi to Tete and thence overland up the Mazoe or Ruenya River. The distribution of forts and settlements on figure 20 shows this clearly.

Carl Mauch, the first man to publish an account of Zimbabwe ruins (1874), used the Ruenya part of the route when returning to Europe from Zimbabwe in 1872.

About 1700 the Rozwi under Shangamire so harried the Portuguese that all posts in Mashonaland were given up and never permanently reoccupied. Certain new Zambezi posts, e.g. Feira, were, however, established early in the nineteeth century.

c. NGUNI INVASIONS (1823–1838) (FIG. 21)

Clear and unmistakable historical evidence begins only in the 1820's when Nguni-speaking groups, driven out of Zululand by the tyrant Shaka, came through our area, destroying the Rozwi power in Iron Age B and making the country desolate.

Of the first two groups of invaders one, the Angoni under Zwangendaba, did great damage before passing on to the north. The third group, Mzilikazi's Matabele, settled in our area, giving their name to the western half of the country.

It is because we have so much unimpeachable evidence of these movements that especial care has been taken to plot them on figure 21.

Zwangendaba's route is given by traditional evidence collected by Lancaster (1937) and Rangeley (unpublished). As the events took place a bare century before the traditions were collected they may be taken to be acceptable on their own merits. There is, however, the archaeological evidence for the sack of Iron Age B buildings, most of whose deposits have, or had, as their uppermost level a destruction level which is dated to this period not only by imports in the next lower levels, but also, in one case, by an intrusive (probably Swazi) pot in the destruction level (Robinson, 1959).

Mzilikazi's route is well known from traditions collected by the early missionaries a few years after the journeys were made.

The great importance of this historical evidence lies in the difference between the approaches to our area. Zwangendaba and Sotshangane led bands of men without cattle and their approach from the south was via the Mopane belt between the Limpopo and Sabi Rivers. Mzilikazi on the other hand had large herds of cattle and his routes were

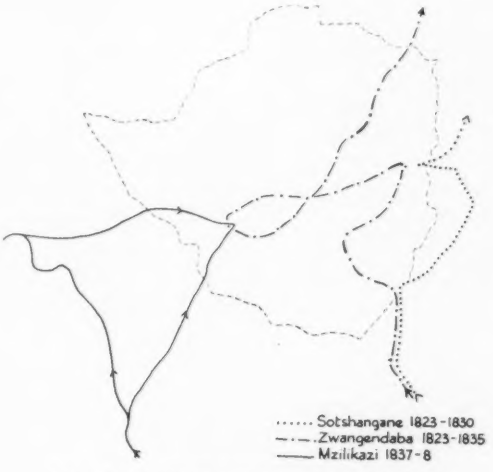


FIG. 21. Routes of Nguni invaders 1823–1838 (from Ritter with additions).

[27] This is based on Shona traditions collected by J. Blake-Thompson (unpublished).

FIG. 22. Early wagon routes.

apparently chosen to avoid the Limpopo Mopane areas.

Here, at last, we have a clue to the reason for the avoidance of Mopane: it was a bad area for cattle.

d. BRITISH AND AFRIKANER TRAVEL (1854–1890) (FIG. 22)

Until 1854 no European had entered this area from the south and indeed none had visited the country since the Portuguese withdrew 150 years earlier.

Moffat's 1854 route has been plotted by Tabler (1954*a*) and he has also plotted the northeasterly extension of this route to Inyati in 1859 by Moffat and to the Hunyani River in 1865 by Viljoen and Jacobs.

Some of this road still exists either as high road or byway today, but a good deal more of it can be traced where tropical rains, running over a cleared section of road, have started eroding deep gullies. Most of Tabler's reconstructions have been made by using old maps and by transferring to modern maps distances recorded by travelers. In 1956, however, he and I, in company with others, traversed a considerable length of the old road working from a known point; on the sections tested, Tabler's reconstructions proved to be remarkably accurate.

This is commonly known in Rhodesia as "Hunters' Road" because it was used by the early elephant hunters.

The strange kink at the northern end shows that this road avoided a Mopane area. A slight straightening was made by Baines in 1869–1870 (Tabler, 1954*b*). This straightening was made because the area through which it ran had become clear of the tsetse fly.

The first centers of white settlement in the area were beside this road: Inyati, Shiloh, Hope Fountain and Bulawayo Missions, John Lee's house and Tati village.

Branching off this road was a road going north to the Victoria Falls (fig. 22, road 2), which was pioneered by Westbeech in 1871/2. This avoided the Matabele area but it was almost waterless and was later altered to run via Tati (road 2*a*), where the Matabele king had a representative. The virtual end of this road was Pandamatenka on the Matetsi River (Tabler, 1955*a*). This road, too, has disappeared but much of it has been recorded for all time as it forms the western boundary of Southern Rhodesia and so has been accurately surveyed.

The extension of this road northward to the Zambezi became possible only after the tsetse fly had become greatly reduced in number. "Fly" was the bane of all early travelers in this country, as they were dependent on oxen for draught.

The connection between Mopane and the tsetse fly will be considered later but the historical patterns of Mzilikazi's and the early Europeans' routes give us our first clue to the importance of Mopane in determining the "personality" of this area.

c. BRITISH OCCUPATION (1890–1893)

The route taken by the British pioneers in 1890 is shown as road 3 on figure 22. The route was selected to be passable for wagons, yet clear of the Matabele area. It remained in use until November, 1893, when the Hunters' Road was opened to all traffic with the overthrow of the Matabele power, after which the stretch between Tuli and Fort Victoria was immediately abandoned.

A few short stretches of this road, between Fort Victoria and Salisbury, still remain in use but most of it has fallen into complete decay. The recovery of fifty miles northeast of Fort Tuli was an exercise in field archaeology which was only undertaken in 1959.

The immediate abandonment of the Pioneer Road is further evidence that, even in the nineteenth century, routes through Mopane areas were most unsatisfactory. The Pioneer Road is, in fact, marked today by a succession of isolated groups of graves where police, transport riders and mail carriers died in this unhealthy stretch of road.

7. PRELIMINARY CONCLUSIONS DRAWN FROM CULTURAL PATTERNS

A number of most interesting points are now clear.

(i) The general avoidance of Mopane areas by both the Matabele and by civilized travelers (except under extreme political pressure) confirms the interpretation of many prehistoric distributions in relation to Mopane areas.

(ii) The validity of the Mazoe/Ruenya route is amply confirmed by long-standing Arab use and by a very clear Portuguese preference for it. The conformity of the Portuguese area in figure 20 to the Ziwa pottery distribution in figure 17 seems too close to be a coincidence. The Portuguese were, however, largely controlled in their penetration by the political confines of the country of Monomotapa and, assuming that this title was a tribal one, we have here a possible further use of this highway.

(iii) The use of the southwest route by Matabele and later by British establishes the existence of a route which had been surmised from the distribution of rock paintings and of certain aspects of Iron Age A cultures.

We may take it therefore that the Mopane belts formed a barrier of some sort and a reason for this, already hinted, now needs to be elaborated.

We also require to investigate possible reasons for the preference for the Mazoe/Ruenya route, instead of, say, the Umniati or Gwaai routes.

Let us deal with the Mopane problem first.

8. THE MOPANE BARRIER

While all prehistoric settlement in Southern Rhodesia seems to have avoided the eastern mountains and to have preferred the woodlands which provided the best facilities for hunting, yet ample evidence has been adduced to show that there was a marked aversion to Mopane woodland throughout the whole prehistoric and historic periods.

The reason for this objection is not at first obvious since Mopane woodland contains nearly as much game as other woodlands and although it is usually in warmer areas, the country is by no means inhospitable. The difference between the attitude of the Angoni, who traveled without cattle, and that of the cattle-keeping Matabele to Mopane woodland, taken in conjunction with nineteenth-century British avoidance of Mopane, seems to provide the clue—the presence of the tsetse fly in the Mopane covered areas.

Glossina morsitans, the insect vector for cattle ngana and for Rhodesian sleeping sickness in humans, is known to find the edges of woodland a favorable place for breeding, whilst most species of game, except pachyderms, provide it with food. *G. pallidipes*, another vector for both human and animal diseases, finds the same environment favorable for breeding, but its food habits are much more restricted, as it apparently feeds only on bushpig and small antelopes and seems to prefer man and cattle. Both species are present today in Southern Rhodesia (fig. 23).

The cool and sometimes cold winters experienced on the high veld are fatal to the adult insects whilst well-drained soils prevent the development of the puparium. Under any conditions the Gusu forests on the Kalahari sand must have been inimical to the puparia, but during drier periods the higher temperatures and higher soil humidity, which favor the extension of Mopane, would also seem to favor the spread of the tsetse fly (Buxton, 1955: *passim*). Although there is no evidence of a definite breeding season, all activities tend to be stimulated in the wet (hot) season and reduced during the dry, cold season. It is, therefore, often possible to move cattle through small fly belts with little loss in the winter. It is also

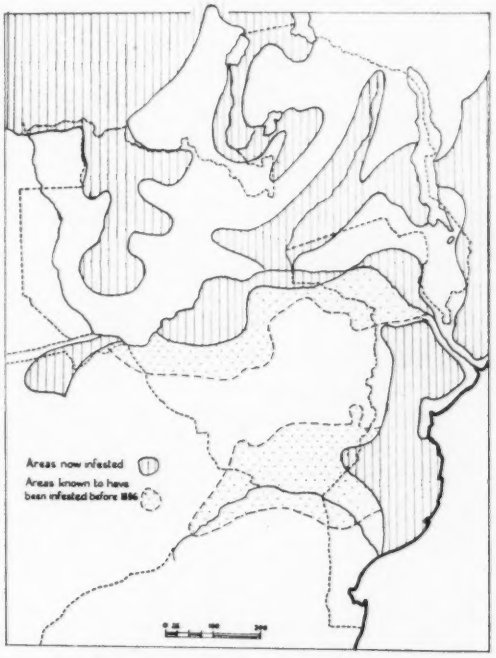


FIG. 23. Distribution of *Glossina morsitans* in Central Africa (compiled from Buxton, 1955).

possible to move cattle at night as *Glossina* are not night flyers.

Let us first consider the effect of the tsetse fly during the Stone Age before Man had any domesticated animals. If we assume that the distribution of *G. morsitans* was largely the same as Mopane woodland [28] from the Middle Stone Age onwards and that *Trypanosoma rhodesiense* has been in existence throughout the period, it will be seen that any hunting party venturing into the Mopane areas even in wintertime was liable to contract Rhodesian sleeping sickness. This is an acute disease and, although not immediately fatal, it is crippling within a few hours in most cases. In a settled community such a disease would have been dealt with by various physical and magical therapeutic methods, which basically amount to rest and nursing, but with a hunting people constantly on the move, any sort of acute disease would at once destroy mobility and prevent hunting. Accordingly, either the whole party would be imperiled or the patient would have to be abandoned.

Moreover, Rhodesian sleeping sickness can be transmitted from man to man direct by tsetse fly bites and today is epidemic, so it is likely that in a party once stricken the disease would affect many individuals. It would not take long for Early Man to perceive the apparent connection between a mysterious crippling illness and a particular type of vegetation—for Mopane veld has a very characteristic appearance. He would therefore avoid that type of country and teach his children to keep out too leaving an archaeologically sterile patch where the Mopane trees grew.

Let us now turn to the effect of tsetse fly after Man had acquired domestic animals. Cattle of all sorts is even more susceptible to trypanosomiasis than Man is and once bitten the animal usually succumbs. Sheep and goats are as prone to this disease as are cattle and even dogs and chickens do not escape. For all practical purposes, tsetse fly infested country is uninhabitable by any sort of domestic stock.

It is extremely doubtful that primitive man realized the connection between tsetse fly and human animal diseases. However, it should not have passed his wit to recognize visually the connection between a particular type of environment with crippling sickness,[29] and in the evident distaste which Man has shown for Mopane bush from at least the Middle Stone Age to the end of the nineteenth century, we seem to have a realization that this was "bad country." Prehistoric man's argument was an empirical one no doubt, but despite this, it has been shown to have a sound basis.

Despite Mopane's pleasant appearance—it reminds one of rather stunted beech woodland, even to the red-gold color of its dead leaves—and the large quantity of game which originally inhabited it, this type of country has, nevertheless, provided a very potent barrier owing to the tsetse flies which it harbored.

9. GATES AND CORRIDORS

A reason for the Mopane barrier having been found, it is now clear that there have been very formidable barriers lying athwart our area.

During the wetter Periods W and X, the barriers seem to have been down and one can see why it is that Sangoan and Still Bay cultures have a ubiquitous distribution.

During the intervening drier periods, the very slightly wetter Period Y and even the markedly wetter Period Z, these barriers existed. The distribution of Magosian, Wilton, and Iron Age cultures is, therefore, understandably restricted, for instead of being open to all comers, the area becomes a corridor with gates at either end. These gates were particularly important during the Iron Age, for the Mopane barriers were of greater importance than in earlier times because of the effects of trypanosomiasis on domestic animals.

Before going into details we must mention that today [30] and in historic times (since about 1860) there is a short period fluctuation of tsetse fly infestation, for reasons not yet understood (Buxton, 1955). Baines (Wallis, 1946: **3**: 714, 771–773) refers to the advance and retreat of the "fly belt" in the Hartley area and in 1869–1870 he undertook the survey and opening-up of a "cut-off" to shorten the Hunters' Road by eight miles because of this retreat (Tabler, 1954*b*). In the Panda-ma-Tenka area there was also a fluctuation, culminating in a retreat of the fly belt; this, however, is said to have been due to the destruction of large herds of buffalo (Tabler, 1955*b*: 309).

[28] Although this can be implied from Buxton (1955), that authority is not specific on this point. It has, however, been discussed with officers concerned with tsetse control and they agree that it is not at all an unreasonable assumption.

[29] Compare the connection between Malaria ("ague") and marshy country recognized in Europe since Roman times.

[30] At the present time (1959) infestation is increasing rapidly, despite drastic attempts to control it.

These barriers are however pierced by narrow gaps which we may call "gates."

a. MAZOE/RUENYA GATE

The Mazoe/Ruenya gate is obviously a most important one and was presumably fly-free or nearly so for long periods. Nowadays it is clear of fly, but the distribution has changed greatly since the rinderpest epidemic of 1896. Buxton (1955: fig. 65, from Chorley, 1947) gives a pre-rinderpest distribution which shows the Ruenya to be on the edge of the fly belt (fig. 23). It may well be that the boundary in the Mazoe/Ruenya area was a fluctuating one, like that in the Hartley area.

This gate faced fly-free lanes in Northern Rhodesia and Nyasaland, all of which join up and lead through Tanganyika to the plateau of Kenya, whence our first Metal Age cultures may well have originated (see page 28).

b. THE ZAMBEZI VALLEY

Although small scale maps show *G. morsitans* right up to the Zambezi in places, very large areas along the river were in fact clear before two hundred miles of the valley were flooded by the building of the Kariba Dam and it may be that this was also the case when the earliest Channelled Ware people arrived, even if it has not always been so.[31] It is also possible that the earliest farmers in Iron Age A did not possess cattle, for they do not seem to have clashed with the Later Stone Age hunters as usually happens when a cattle-owning people moves into a hunting area.

c. THE SOUTHWESTERN GATE

The southwestern gate, by which the Sotho cultures entered the Union of South Africa and through which the Rozwi cultures seem to have entered Southern Rhodesia, was also controlled by the presence of a tsetse fly (*G. morsitans*) belt which existed in the Limpopo Valley until 1896 when it disappeared under the combined impact of rinderpest (which killed off much of the wild game) and European hunting and settlement (which obliterated the remainder) (Dicke, 1932). This belt of tsetse infected country prevented any direct southward movement by compelling cattle-owning people to follow the left bank of the Limpopo and Marico Rivers for a very long way before they were able to turn eastwards from the Bechuanaland grasslands at about 26° S. Much of the western part of our area may well have been free of fly during the whole of the Iron Age, so the southwestern gate was a very wide one, being restricted westwards only by scarcity of water.

d. THE SOUTHEASTERN GATE

It is thought possible that there may have been another gate on our southern borders, namely from the Mozambique plain up the Sabi-Lundi Valley.

The distribution of early stone buildings and a distinct type of pottery associated with them[32] is restricted to the southern part of Mashonaland and has not so far been found north and east of the Sabi and Ruzawi Rivers despite the fact that this is a quite well-known area archaeologically.

This area, well watered and good for both agriculture and cattle raising, is closed on the southeast by areas originally infested with tsetse fly, but is connected through mountain passes to an area in the eastern foothills of the Chimanimani Mountains, which is clear of fly and which communicates with the Ruenya area, but which is closed to the south by a broad fly belt stretching right down to the coast.

One may, therefore, envisage the early builders of Zimbabwe coming into Southern Rhodesia over the southern passes through the Chimanimanis.

e. ABSENCE OF GATES FROM AREAS WHERE THEY ARE TO BE EXPECTED

(i) Gwaai Valley: Although the upper waters of the Gwaai have been extensively explored, the lower parts have not been entirely neglected. These have yielded a few Sangoan and Middle Stone Age sites, but nothing from the Later Stone Age although there is clear evidence (p. 278 and fig. 14) that Later Stone Age Man crossed the Zambezi near the mouth of the Gwaii. It seems, therefore, that the Gwaai, which was a corridor in Sangoan and Middle Stone Age times, was not used as a gate to the watershed corridor by later people.

(ii) Umniati Valley: This area is far less well known. Nevertheless, it is not entirely unexplored, especially in the Kariba Lake area. Here stone implements are very rare indeed and there are but one Earlier Stone Age and four Sangoan

[31] The distribution of Wilton sites along the Zambezi provides additional evidence for a clear corridor on the river banks even in dry periods.

[32] The pottery is Zimbabwe Class 3 (Robinson, 1960) which is approximately equatable to Schofields R_2 (1932, 1948).

sites, other cultures not being represented. Pending more investigation we may provisionally conclude that these valleys did not form a gate after Sangoan times (Period W).

(iii) Hunyani Valley: Unfortunately exploration has not been pursued sufficiently for any conclusion to be drawn as to early cultures, but the distribution of rock paintings suggests that once again an expected route was not used. It may be, however, that this route was used early in the Iron Age.

It will, therefore, be seen that some expected routes leading southwards from the Zambezi Valley were apparently ignored after the Middle Stone Age and little used before. Figure 4 shows the existence of Mopane filled valleys in the case of the Gwaii and the Umniati and these alone would account for the lack of use of these gates. As to the Hunyani, we can only record that Man seems to have preferred to travel up the Mazoe/Ruenya, perhaps because conditions outside the borders of Southern Rhodesia made it a more obvious approach route.

10. THE "PERSONALITY" OF SOUTHERN RHODESIA

Throughout our study it has been clear that Southern Rhodesia has frequently been a species of northeast-southwest corridor connecting the lower Zambezi Valley to the upper Limpopo.

Evidence for a corridor during the Earlier Stone Age (Periods U and V) is very scanty, but sufficient exists for us to say that during the final phase (Period V–W) there was some such corridor along the crest of the watershed.

The spread of forests in Period W did away with this corridor effect and the individuality of our area became submerged in that of the Great African Equatorial Forest.

At the conclusion of this extremely wet period the corridor effect became more marked and even the wet Period X did not entirely do away with it, although at this time the watershed corridor became very much wider.

The walls of the corridor we have shown to consist of light Mopane woodland which was, and still is, dangerous to Man the Hunter and especially so to Man the Herder. Consequently the individuality of our area became even more apparent as Stone Age food-gathering cultures gave place to food-producing ones of the Iron Age.

This woodland itself formed no physical barrier but it was, and is, the home of the insect vector of human and animal trypanosomiasis. Until 1895–1896, when rinderpest killed off nearly all the wild hosts of the vector, these Mopane woodlands were as impassable to civilized Man of the late nineteenth century as they were to the men of the Later Stone Age living in a pre-civilized stage of human development.

The entries to this corridor were by the Mazoe/Ruenya Rivers and by the Tati area of Bechuanaland Protectorate. Only rarely did other entrances open.

The direction of movement through this corridor has varied from time to time. During the Earlier Stone Age it is probable that the movement was northerly; at other times it seems to have been southerly, but northward movements are clear in the later part of the Iron Age, although these are but resurgences of people who had previously passed southwards through the corridor.

One must not think, however, of the migrant people and ideas as passing hurriedly through Southern Rhodesia to some objective in the far north or south; the movements were deliberate and local developments took place all the time. This can be well seen in rock art whose development in the west of our area has been carefully studied by Cooke (1957, 1959), but it is to be seen at its best in the Iron Age A cultures where the pottery shows a steady development in specific areas such as the Mazoe basin and the western watershed. The architecture of Iron Age B shows a similar local development, untouched by developments elsewhere (Whitty, 1959).

On the whole, however, the local cultures of Iron Age B (often called the "Zimbabwe Culture" although this is but one of several) demonstrate the result not only of local development but of the mixing and mutual enrichment of cultures originating in widely different places and meeting in our area. The easily available mineral wealth of the area—especially of gold—provided one economic basis for this local culture complex, but good grazing was probably just as attractive to Iron Age B peoples as it was to the later Matabele and the more recent European immigrants, also from the south. Another mineral which seems to have led to localized cultural development was easily available building stone. A good deal of Southern Rhodesian granite splits easily under the alternate application of fire and water—a technique well known to the miners of the local Iron Age A—and Whitty (1957; 1960) has suggested that local architectural developments have

been stimulated by the local abundance of suitable stone. I would endorse Whitty's view.

Looking beyond the borders of our area (fig. 23), we can see why it is that development of prehistoric cultures in Northern Rhodesia seems to have proceeded on different lines from those of Southern Rhodesia, even when both areas have received their original stimulus from the same source.[33] The Zambezi Mopane barrier effectively separated the two Rhodesias throughout much of prehistoric time.

On the other hand prehistoric rock art shows that the connections between East Africa and Southern Rhodesia are clear as are those between Southern Rhodesia and South Africa, South West Africa and Angola (Summers, 1959); here the Mazoe/Ruenya and the southwestern gates provide suitable routes for the artists.

Thus we see that Southern Rhodesia, an artificial unit whose boundaries were determined as a result of nineteenth-century politics in Europe, nevertheless possesses an individuality—indeed a personality—which differs from its neighbors. This personality arises partly as a result of the geographical factors of mountain and desert, but these have proved less important than the presence of noxious insects—tsetse flies—which effectively converted this area into a kind of "landlocked island," where cultures have developed, sometimes in comparative isolation but sometimes stimulated from outside, and in turn stimulating other areas. The country's natural wealth has stimulated local development from the Later Stone Age onwards, and the nineteenth- and twentieth-century British and South African settlers are but the latest of a stream of settlers and visitors of many origins who have made their homes in this favored area.

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I am most grateful to them all.

[33] These differences are very noticeable in the Late Stone Age (Wilton and Nachikufan cultures) (Clark, 1950: 107), in rock art (compare Clark, 1959*b*, with Cooke, 1959) and also seem to have occurred in the Iron Age (personal communication from Mr. R. R. Inskeep).

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DAVID HOSACK'S HERBARIUM AND ITS LINNAEAN SPECIMENS

CHRISTINE CHAPMAN ROBBINS

In 1794 Dr. David Hosack * returned to New York City after two years in Great Britain. He brought with him a herbarium which included duplicate specimens from the Linnaean Herbarium, given to him by James Edward Smith * of London who had some years previously purchased the Linnaean collections. There is no record of the number of specimens or of the genera and species represented. From descriptions of the specimens in the herbarium of the Linnean Society of London, the plants were probably mounted on small sheets of paper (32 cm. × 20.5 cm.) and the information given on the sheets was meager. They may have been bound in one or more volumes. The specimens are usually authenticated by a number, namely, that prefixed to the species in *Species Plantarum*, 1753, followed by the "trivial" name.

Hosack's herbarium, including the Linnaean specimens, passed into the possession of the New York Hospital, later into that of the New-York Historical Society, and finally was owned by the Lyceum of Natural History of New York. It dropped out of sight in 1830 when it formed a part of the cabinet of the Lyceum. It was probably destroyed by fire in 1866, though I have been unable to find documentation for this assumption and it may still exist in some forgotten place.

Without doubt, the Hosack Herbarium contained the only substantial number of Linnaean specimens ever brought to the United States. C. Earle Smith, Jr., has reported a specimen from Linnaeus in the Muhlenberg Herbarium at the Academy of Natural Sciences of Philadelphia.[1] M. L. Fernald states that "bits of types of Linnaeus" are preserved in the personal herbarium of Asa Gray in the Gray Herbarium, Harvard University.[2] These are the only references I have located to specimens in the United States from the Linnaean Herbarium, aside from those brought by Hosack in 1794.

The Linnaean Herbarium, preserved by the Linnean Society of London at Burlington House, Piccadilly, is the most important reference collection of seed plants in the world. It is used to typify the Linnaean specific or "trivial epithets" and generic names which, by the International Code of Botanical Nomenclature, are the earliest names for seed plants. The name permanently associated with the original type specimen, together with the description, anchors that particular name. Almost every botanical taxonomist has occasion, sooner or later, to consult the Linnaean Herbarium. Any substantial number of Linnaean specimens, such as those Hosack brought to the United States, would have, therefore, unique importance in the botanical world.

ACQUISITION OF A HERBARIUM BY DAVID HOSACK AND ITS TRANSFER TO NEW YORK CITY

At the age of twenty-two, David Hosack, M.D., born in New York City, August 31, 1769, was well launched on his medical career. His elementary education included excellent instruction in the classics; his college years were spent at Columbia College (1½ yrs.) and Princeton (College of New Jersey), where he was graduated with an A.B. degree in 1789. Two years later he was granted an M.D. from the University of Pennsylvania. He had received the best medical education to be obtained in America and had been in contact with some of the most eminent medical men of his day.

While a medical student in Philadelphia, he was "domesticated in the family of the distinguished Dr. Benjamin Rush." *[3] A father-son relationship was established which characterized their correspondence despite later differences of opinion.

As a part of his medical instruction at the University of Pennsylvania, Hosack must have studied the subject, "Materia Medica." The Professor of Botany and Materia Medica of the Medical Faculty at the University of Pennsylvania, Dr. Adam Kuhn,* had received his M.D. from the University of Edinburgh in 1768. Previously, he had spent two years, 1762–1764, as a student of botany at the

* Member of the American Philosophical Society.

[1] Smith, C. Earle, Jr., Report of a study of the Muhlenberg Herbarium. *Yearbook Amer. Philos. Soc.* for 1959: 271, 1960.

[2] Fernald, M. L., Early botanists of the American Philosophical Society, *Proc. Amer. Philos. Soc.* **86**: 63–71, 1942.

[3] Herring, James, and James Longacre, David Hosack, M.D., F.R.S., *National portrait gallery of distinguished Americans* **2**, 1835.

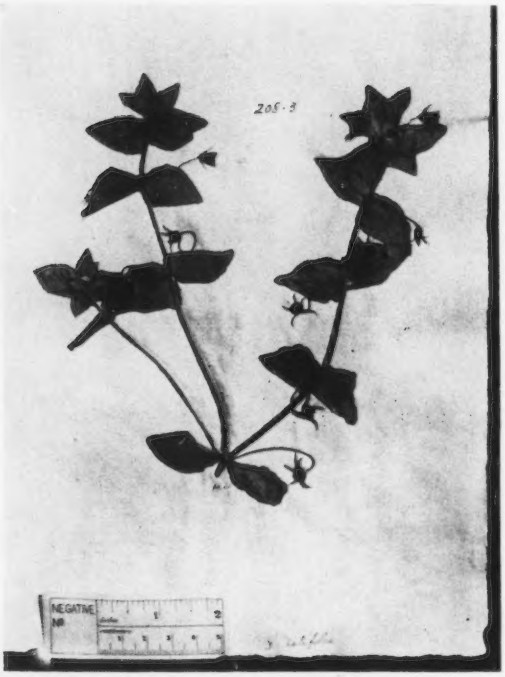

FIG. 1. *Anagallis latifolia*, a specimen from the Linnaean Herbarium, Linnean Society of London. This is representative of the kind of material given Hosack by Sir James Edward Smith.

University of Upsala, Sweden, under Professor Carl Linnaeus,* a friend of his father.[4]

Hosack's interests may have been slanted toward botany and the importance of plants in medicine by Kuhn. Darlington,* however, wrote, "although he [Kuhn] had the advantage of studying under the illustrious Swede [Linnaeus] and was said to have been a favorite pupil ('Linneo ex discipulis acceptissimus'), it does not appear that he ever did much for the Science."[5] What influence Kuhn's training in botany had on young Hosack is difficult to determine. The fact that Rush, Kuhn, and the majority of the well-known physicians of the day had degrees from Edinburgh, the center of the medical world for two decades before and after the American Revolution, with a little polish from London, made a tremendous impression upon Hosack.

[4] Thacher, James, *Amer. Med. Biogr.* 1: 349–352; 2: 29–71, 1828.

[5] Darlington, Wm., *Memorials of John Bartram and Humphrey Marshall*, 21, 1849.

Equipped with his medical degree, David Hosack married [6] and established himself in practice in Alexandria, Virginia, where he became more and more

convinced that the distinction which our citizens at that time made between those physicians who had been educated at home and those who had had additional instruction from the universities of Europe, and knowing how little property I had reason to expect from my parents, I found that my chief dependence was upon my own industry and unceasing attention to the profession I had chosen as the means of my subsistence; my ambition to excel in my profession did not suffer me to remain insensible under such distinction. Although it was painful for me to think of leaving my family, consisting of a wife and child, I accordingly suggested to my father the propriety of my making a visit to Europe and of attending the medical schools of Edinburgh and London. He at once with his characteristic liberality acquiesced in my views and wishes. In August, 1792, leaving my family to the care of my parents, I took passage to Liverpool.[7]

When Hosack planned his trip abroad, he apparently did not contemplate remaining long enough to obtain a degree—he merely planned to take some of the courses given to students of medicine there. In Edinburgh, and similarly when he went to London, the subjects he studied in the hospitals were of a type given to the regular medical students with whom he was associating; there was at that time no formally organized post-graduate course. His major aim was probably to return to New York with the added prestige of having studied at Edinburgh and London with whatever that might mean in the way of the latest and best available medical information.

Although devoting himself almost exclusively to medicine during his stay at Edinburgh, a fortuitous invitation brought to his attention the importance of the science of botany. At Edinburgh he attended the lectures of Dr. Alexander Hamilton, Professor of Medicine, who was assisted by his son, James. Invited with others to visit the Hamilton home, "Blandford," near Edinburgh, Hosack strolled through the gardens with the other guests and reported himself as "mortified by my ignorance of botany" [7] with which the other guests were

[6] David Hosack of New York and Miss Kitty (Catherine) Warner of Princeton, N. J. were married at Princeton, N. J., April 14, 1791 (*New York Daily Gazette*, Apr. 21, 1791).

[7] Hosack, Alexander E., Memoir of the late David Hosack by his son, *Lives of eminent American physicians and surgeons of the 19th century*, ed. by S. D. Gross,* 289–337, Philadelphia, 1861.

familiarly conversant. He determined to do something about it.

In the spring of 1793 Hosack left Edinburgh to visit his father's birthplace at Elgin in northern Scotland, a rich experience. He was not, however, long away from his studies, as he soon proceeded to London where he superimposed an intensive study of botany upon his medical courses.

Youmans quotes Hosack as saying:

> I had resolved at that time [his visit to Blandford] whenever an opportunity might offer, to acquire a knowledge of that department of science. Such an opportunity was now presented and I eagerly availed myself of it [at London, summer, 1793]. The late Mr. Wm. Curtis, author of "Flora Londinensis" and the Botanical Magazine, had just completed his botanic garden at Brompton which was arranged in such a manner as to render it most instructive to those desirous of becoming acquainted with this ornamental and useful branch of medical education. . . . He, at my solicitation, undertook to instruct me in the elements of botanical science. For this purpose I visited the botanical garden daily throughout the summer [of 1793]. I also had the benefit once a week of accompanying him [with others] on an excursion.[8]

For use in his teaching of the subject of botany, Curtis had prepared a series of lectures which were later published by his son-in-law, Samuel Curtis, in two volumes, with well-known botanical illustrations. These published lectures probably include much of the information on botany that Curtis imparted to his pupil, David Hosack. A comparison of Curtis' lectures with a syllabus of Hosack's lectures on botany, subsequently published, shows considerable similarity between the two, as might be expected.

> In the autumn, [Hosack said,] I also attended the public lectures of botany delivered by the president of the Linnean Society, Dr. [later Sir] James Edward Smith, and by the kindness of the same gentleman I had access to the Linnaean herbarium. I spent several hours daily for four months examining the various genera, and the most important species contained in that extensive collection. Notwithstanding my attention to botany, I was not unmindful of the other departments of medicine.[8]

Dr. Smith, at this time, was thirty-five years old. He had purchased the Linnaean collections ten years previously in 1784. Although Smith had studied medicine for a period at Edinburgh, he ultimately received his M.D. at Leyden in 1788. His prestige was due, in large part, to his ownership of the famous Linnaean Herbarium. In enterprise and character, Smith was much the prototype of Hosack and the two men, definitely congenial, formed an affectionate friendship fostered through correspondence which continued until the death of Sir James in 1828.[9]

Smith moved with his collections, including the Linnaean Herbarium, in 1788 to 12 Great Marlborough Street (now off Regent Street) where Hosack doubtless consulted the herbarium.

Hosack could not have failed to realize how influential the possession of the Linnaean collections had been in elevating the young and hitherto unknown James E. Smith to a position of eminence, not only in London but in the whole scientific world. It was certainly about this time that Hosack formed the plan to equip himself with as good a herbarium as he could obtain—thinking of it as a necessary and valuable aid in the study and teaching of materia medica.

Through his friendship with Smith, David Hosack was elected a Fellow of the Linnean Society of London in the year 1794[10] and received from Smith a gift which is later described as "duplicates from the Hortus Siccus of Linnaeus."[11]

During the summer of 1794, David Hosack's period of study in London came to an end and reinforced with the knowledge obtained, as well as with the books, minerals, and plant collections he had acquired, he returned to New York on the "Mohawk," making a passage of fifty-three days. Soon after his arrival, he wrote at length to his former teacher and intimate friend, Dr. Benjamin Rush, at Philadelphia, to tell him of the use of his time abroad, his acquisition of a herbarium, and something of his future plans for continuing his studies at home:[12]

> I am very happy to write from my native land having just arrived from Britain. . . . Two years since I left America. . . . In two or three lines, I tell you what has been my employment during my absence. When in Edinburgh I heard the different lectures of the University and attended the Infirmary.

[8] Youmans, Wm. J., *Pioneers of science in America*, 103, 1896.

[9] Hosack named one son James Edward Smith Hosack after his friend. He died as a young man. Alexander E. Hosack in the memoir of his father says: "The acquaintance thus begun with this distinguished botanist, Sir James Edward Smith warmed into an affectionate friendship, which judging from his letters to my father, now in my possession, continued uninterrupted during their lifetime." I have not located these letters.

[10] Gage, A. T., *History of Linnean Society of London*, 134, 1938.

[11] Anon., *Description of Elgin Garden, the property of David Hosack, M.D.*, no date.

[12] David Hosack, New York, to Dr. Benjamin Rush, Philadelphia, Sept. 8, 1794. Library Co. of Philadelphia.

In London I spent fourteen months. My attention was more directed to what are called the ornamental —though I find them equally necessary—branches of the Profession, Natural History, Chemistry and if you may so call it, Philosophy of the mind as well as of the Body. Last winter I spent in anatomical pursuits, especially dissection.

Natural History became my favorite pursuit as I had very particular advantages from my acquaintance with Sir Joseph Banks,* Dr. James Edward Smith, Prof. of the Linnean Collection, Dr. Woodvile[13] [Wm. Woodville] of Medical Botany, and Mr. (Wm.) Curtis, author of "Flora Londinensis" and by them privilege of botanic gardens.

I have also, as I may call it an almost untrodden field in this country for those pursuits—availed myself of the opportunity and accordingly made many sacrifices for providing the necessary materials for promoting those subjects, an extensive Library, chemical apparatus, an Herbarium and a collection of necessary objects of natural history, as mineralogy.[14]

As time allows I will devote my winter to Zoology and my summer to Botany, giving some attention to mineralogy. On the score of industry and intention, I feel myself more secure.

I take the opportunity to mention to you Dr. Smith of London as a gentleman who would make a most valuable member of your American Philosophical Society. You, no doubt, know his character as President of the Linnaean Society of London. . . . Your affectionate pupil.[15]

Hosack does not describe the herbarium in this letter, but from other sources, it is clear that it contained duplicate material from the Linnaean Herbarium which had been given him by Dr. James Edward Smith.

It may be that Dr. Hosack looked forward to an appointment in a medical college,[16] as well as a career in medical practice, when he gave such a large part of his time in London to the study of botany and took such pains to secure a herbarium, library, and a collection of minerals. Coming home as he did, equipped with the latest information available in London on the subject of botany, and with the additional advantage of collections he had been foresighted enough to obtain, he represented a type of knowledge and of equipment that was without parallel in the New York City of that day.

Events began to shape up soon after his return to New York, as Hosack hoped they would. He was offered a teaching position. In May, 1795, Samuel L. Mitchill * resigned his botanical professorship in the medical school of Columbia College and Hosack was appointed his successor; in the following year, upon the death of Dr. William P. Smith,* Professor of Materia Medica, Hosack was elected to the joint professorship of botany and materia medica. He held these two professorships until 1811.[17]

As a teacher of botany and materia medica, Hosack looked back to the advantages he had enjoyed in Wm. Curtis' Brompton garden:

> I now readily perceived that an abstract account of the principles of these sciences, as taught by books, coloured engravings, or even with the advantages of an herbarium, must necessarily be very imperfect and unsatisfactory, when compared with the examination of living plants, growing in their proper soils with the advantages of culture; . . . and that a botanical establishment was indispensably necessary in order to teach this branch of medical science with complete effect.[18]

Since at this time (1796) Hosack was unable to obtain from other sources the necessary financial support for the purchase and development of the "botanical establishment" he envisioned, he undertook in 1801 the project himself and founded the Elgin Botanic Garden [now included in the area called Rockefeller Center], located on "Middle Road" four miles from the New York City of that day. Here, Hosack established and maintained his herbarium for the use of his students; we find it referred to at this location in an anonymous pamphlet entitled "Description of Elgin Garden,

[13] William Woodville, M.D. "Physician to Smallpox Hospital, King's Cross where he had a botanical garden from 1791." Author of a three-volume medical botany (Britten and Boulger, 334).

[14] Hosack gave his mineralogy collection to Princeton University. It was arranged by John Torrey in 1814. Torrey to Amos Eaton, July 30, 1814. Gratz Collection, Hist. Soc. of Penna.

[15] Sir James Edward Smith was elected a member of the American Philosophical Society in 1796.

[16] In a letter to Wm. Rawle * of Philadelphia, 1819, Hosack expressed himself as willing to assume a professorship in the Medical School at Philadelphia because it would relieve him of the need of practicing medicine and give more time for teaching and writing. Hosack to Wm. Rawle, Feb. 1819. University of Penna. MSS. **8**: 31.

[17] M. H. Thomas, Columbia University, to Clarence McKay Lewis, Jan. 10, 1947: "The records of the Treasurer of Columbia College do not show any payments to Hosack while he held the title of professor here. His income was entirely from his students who paid him directly in each course they took, receiving at the time of their registration a ticket entitling them to admission to the lectures. All medical schools in those days were run on a proprietary basis and the only connection with the colleges to which they were attached was a degree-granting relationship."

[18] Hosack, David, *A statement of facts relative to the establishment and progress of the Elgin Botanic Garden*, 6–7, 1811.

the Property of David Hosack, M.D." [19] which is probably an offprint of an article of the same title in the Medical Repository [20] edited by Dr. S. L. Mitchill and Edward Miller.* The article may have been written by Mitchill or by Hosack himself. The pertinent statement is as follows:

> Dr. Hosack has also connected with this establishment [Elgin Botanic Garden] an extensive Herbarium which contains not only a great variety of plants collected by himself in Great Britain, and in this country, but is also enriched by many valuable specimens furnished by the late celebrated Danish Professor Vahl; by [Wm.] Curtis and [James] Dickson, and by duplicates from the Hortus Siccus of Linnaeus presented by Dr. Smith, the learned President of the Linnaean Society, and the present possessor of the rich collections of the celebrated Swede.
>
> To this establishment Dr. Hosack has also added a well-chosen Botanical Library, consisting of the most celebrated works both ancient and modern which are necessary to illustrate that science, as well as its application to medicine, to agriculture and the arts to which it is subservient.

The above statement that Dr. Hosack brought to New York original specimens which had been prepared and named by Linnaeus himself, and that they were duplicates of the collection then owned by Dr. Smith, is definite and unequivocable. It is supported by a report on botany and vegetable physiology by David Hosack on April 8, 1817, to the New-York Historical Society, by a record in the minutes of July 18, 1817, of the New-York Historical Society, and by a note in the minutes of November 29, 1830, of the Lyceum of Natural History of New York. These evidences will be presented in detail later.

The assistant Secretary and Librarian of the Linnean Society, Spencer Savage, in a letter addressed to Clarence McKay Lewis in 1947, wrote that he [Savage] failed to find any evidence that Sir J. E. Smith gave any Linnaean plants to his pupil (Hosack) and requested evidence that the gift was a "well-authenticated fact." From the records cited above the existence of Linnaean Herbarium duplicates brought to New York by Hosack in 1794 is a "well-authenticated fact."

Among the secondary sources referring to Hosack's Linnaean duplicates are the following:

Appleton's *Cyclopedia of American Biography* (1887), in a short biography of David Hosack, states "In 1794 he [David Hosack] returned to New York with a duplicate collection of plants from the herbarium of Linnaeus which now constitutes a part of the Museum of the Lyceum of Natural History of New York."

In a biography appearing in the *National Cyclopedia of American Biography* (1907 ed., **9**: 354), Hosack's collections are referred to as follows:

> He [David Hosack] rendered notable service to science by bringing from England the first collection of minerals that had been introduced into this country, and a duplicate collection of plants from the herbarium of Linnaeus. His life-long enthusiasm was, however, botany, which next to his profession occupied his time.

Addison Brown says,

> Returning to New York, Dr. Hosack took with him the first considerable cabinet of minerals brought to this country and also duplicates of the herbarium of Linnaeus, afterwards given by him to the Lyceum of Natural History, but since destroyed by fire.[21]

Doubt has been expressed that there were duplicates in Smith's Linnaean Herbarium. The younger Linnaeus is credited by Benjamin D. Jackson with the statement that there was little or no duplicate material in his father's collection. Jackson quotes from a letter the younger Linnaeus wrote in 1779: "My late father weeded out his herbarium while he was able to work and seems to have burned all the duplicates, why, no one knows." [22]

Despite this statement by Linnaeus' son, duplicate herbarium material, including Linnaean, was given by Smith to Sir Joseph Banks. The *Proceedings* of the Linnean Society of April 2, 1903, record the following relative to an interchange of specimens for Banksian material:

> During the autumn of 1902, when examining some unbound letters and manuscripts belonging to Sir James Edward Smith, a small octavo note-book was found headed "Desiderata Banksiana, January 1785," of seventeen leaves, with names of plants in double columns and on the last leaf a note in pencil thus: "circa 2000; Feb. 9th communicata ex H. L. patris 81 [ex H[erbario]L.[innaei] patris." A few of these have been compared with the Linnaean herbarium to make certain that only duplicates were parted with by Smith in this exchange, by which the herbaria of Banks and Smith were enriched at the expense of the Linnaean herbarium.[23]

[19] A copy of the anonymous pamphlet at the Library of the Gray Herbarium, Harvard University can be seen at the Library of the American Philosophical Society.

[20] *Medical Repository*, 3rd Hexade, **1**: 295, 1810.

[21] Brown, Addison, The Elgin Botanic Garden, *Bull. New York Botanical Garden* **5**: 318–372, 1909.

[22] Jackson, Benjamin, D., Notes on a catalogue of the Linnaean Herbarium Suppl. to *Proc. of Linn. Soc. of London 134th Session 1921–22*: 24, 1922.

[23] *Proc. of Linn. Soc. of London*, 10, 1903 (Apr. 2).

FIG. 2. Pastel portrait of David Hosack by Ellen Sharples, 1809–1811. Published by permission of the owner, Miss Alice Biddle of Bryn Mawr, Penna., great-granddaughter of David Hosack. Courtesy of the Frick Art Reference Library.

In his introduction to the 1957 edition of Linnaeus' *Species Plantarum* (page 111), Wm. T. Stearn makes the statement that "Smith gave a few duplicates to others besides [Sir Joseph] Banks, e.g. to [Edmund] Davall, [David] Hosack and [Wm.] Roscoe. . . . Hosack's material, taken to New York seems to have perished." The source of Stearn's information on Hosack is not given.

During the years 1801–1810, while Hosack fostered the growth and development of the Elgin Botanic Garden, he also became prominent as a physician. He had become a partner of the popular and eminent Dr. Samuel Bard *[24] in 1796, was appointed an attending physician of the New York Hospital (on Broadway between Duane and Anthony Streets) where he served from 1797 to 1806 and later from 1807 to 1826, and was a member of the Medical Faculty of Columbia College from 1797 to 1811.

The year 1807 saw the establishment of another medical college in New York City, the College of Physicians and Surgeons, which was given a charter by the New York Board of Regents. This institution was independent of Columbia College.

Hosack was appointed Professor of Theory and Practice of Physic in 1808 in the College of Physicians and Surgeons, though he continued his professorship at Columbia. Amongst his colleagues in the former college were Dr. Samuel L. Mitchill, Chairman of Chemistry and Natural History, Dr. Edward Miller, and Dr. Samuel Bard, who was elected President in 1811 at which time the medical school of Columbia College was absorbed.

Meanwhile, in the year 1808, Hosack found that his expenses for improving and maintaining the Elgin Botanic Garden far exceeded the calculations he had formed and were more than prudence would justify with his family of several children.[25]

[24] Langstaff emphasizes the impression which what he terms "Bard's botanic garden" had upon Hosack. In "Doctor Bard of Hyde Park" (p. 181) he states, "In the hospital [New York] grounds west of Broadway, covering two blocks, in later times bounded by Duane, Worth and Church streets, Sam Bard had already [1791] started planting his botanic garden." This garden, he further adds (p. 189), "had demonstrated what could be done in cultivating medicinal herbs in America . . . also Bard had used it to test the growth of certain plants which might prove profitable as crops at Hyde Park."

Samuel Bard had received botanical instruction from Jane Colden at Coldenham, New York, and from John Hope at Edinburgh where Bard prepared the herbarium later referred to in this paper. In New York he was influential in founding the Society for the Promotion of Agriculture, Manufactures and Useful Arts. The society (1794) went on record as favoring a botanical garden under their direction or that of the college. Bard was sympathetic with Hosack's views and Hosack's attempt to gain financial support for the botanic (Elgin) garden he eventually established at his own expense.

It is difficult to estimate how great Bard's influence was on Hosack. Stoke's Iconography makes no mention of "Bard's botanic garden" nor does Hosack himself refer to it in his "Statement of Fact." In 1804, the "Account of the New York Hospital," issued by the Society of the hospital, refers to the grounds as planted with fruit and forest trees which afford agreeable refreshing walks for patients, but makes no mention of a botanical or herb garden.

[25] Catherine Warner Hosack, first wife of David Hosack, died Feb. 11, 1796, age thirty (Record of First Presbyterian Church in the City of New York). Their son, the first Alexander, died Dec. 29, 1792, age six months (Reg. of Interment, N. Y. Marble Cemetery, N. Y. City).

David Hosack and Mary Eddy of Philadelphia were married Dec. 2, 1797. Mary Eddy, a Quakeress, was disowned by Philadelphia Monthly Meeting for marrying out of unity with the Friends Meeting (Vital Records Philadelphia Monthly Meeting). David and Mary Hosack had 9 children, five by 1808. Mary Eddy Hosack

After a long series of communications to the legislature by Hosack and his supporters, and several postponed hearings, a bill entitled "An Act for Promoting Medical Science in the State of New York" became law on March 12, 1810. Commissioners of the land-office were directed to treat with David Hosack for the purchase of lands comprising the "botanic garden, commonly called Elgin," the purchase money to be raised by a lottery.[18]

The time consumed in having the land and improvements valued, allotments allowed for roads and other details, was such that the management of the Elgin Botanic Garden did not pass to the Regents of the State of New York until January, 1811. Hosack, meanwhile, was feeling financially pressed. He had signed notes with several friends; the reimbursement was, in his figures, $28,000 less than his expenditures for and at the Elgin Botanic Garden, and the payment from the lottery was delayed.

The Regents of the State, now having management of the Botanic Garden, committed it to the care of the College of Physicians and Surgeons (under the Board of Regents of the State of New York) with no right to incur expenses[26] and in June, 1811, the College leased the Garden to Hosack's gardener, Michael Denison. The later history of the Elgin Botanic Garden will not be detailed here.[27]

HOSACK'S LIBRARY AND HERBARIUM AND THE NEW YORK HOSPITAL

At the time of the transfer of the Elgin Garden to the State of New York, Hosack decided to dispose of his botanical library and herbarium; whether this decision was made for financial reasons or for other considerations is not clear. Samuel L. Mitchill, however, surely with the sanction and possibly at the request of Hosack, presented a letter to the Governors of the Society of the New York Hospital, September, 1811, relative to the purchase of Hosack's botanical library. Mitchill's letter was referred to a committee which reported as follows:

That Dr. Hosack is in possession of a Library of Books, on Botanical Subjects, which he offers to dispose of to the Hospital, on the following terms, viz:

That the purchase money shall be paid by the Hospital in three Yearly Instalments, with Interest at 6 PCent Annum.

In case the Governors purchase the Library, Dr. Hosack will present them gratis, with an Herbarium, containing a great number of dried plants, scientifically arranged, and in excellent order—a small collection of minerals, and the Bureau which contains them.

This Collection Dr. Hosack values at Three hundred dollars at least—and the Bureau at One hundred Dollars.

The Committee further Report that the Library consists of Three hundred and thirty three Volumes; but few Duplicates of which, at present belong to the Hospital.

That in this number are comprised about 90, which are out of print, and cannot now be purchased of the Booksellers; and among which are several very valuable works.

This Library is probably the most complete of the kind in America, and if the present opportunity is neglected, Years may elapse before another equally favorable may occur. Such a Collection can only be made, by watching the Sales of private Libraries; and many of the Books descriptive of American, Russian, Swedish, Italian and Indian plants are rare, even in England.

That the probable Sum at which the Library will be estimated is about Two thousand Dollars, according to Doctor Hosack's Calculation—

Considering that this Sum exceeds the expectations formed by the Governors The Committee think it prudent and respectful to ask their directions, before proceeding to conclude a Bargain with Dr. Hosack.

If the Governors should incline to purchase, the Committee would recommend, that a specific Sum be offered to Dr. Hosack—

The Committee have seen the Books, and found them generally in good Condition.

T. Franklin, Chairman.

Ordered that the Subject be referred to a Comm. [of 8 and the Sec.] who are authorized to purchse at the lowest rate, if they think it advisable.[28]

November 5, 1811, report of the Library Committee:

died April 20, 1824 (tombstone, Trinity Cemetery, Westerly Division).

David Hosack married Magdalena Coster, widow of Henry Coster (and cousin of Philip Hone), on Feb. 26, 1825 (Record of Grace Church, 802 Broadway, New York City).

[26] Shrady, in his history of the College of Physicians and Surgeons, p. 57, states: "The College was highly pleased with the acquisition of the Botanic Garden but their gratulations were short-lived. The students did not share in the enthusiasm of Dr. Hosack for botanical pursuits." Dalton remarked "medical students in Barclay St. had something else to do than to make excursions to the Botanical Garden for the purpose of examining rare and valuable medicinal plants."

[27] For a detailed account of this period see Clair Klein, Columbia and the Elgin Garden property, *Columbia Univ. Quart.* **31**: 272–297, 1939.

[28] Minutes. Board of Governors, New York Hospital. Mr. Laurence Payson, Secretary of the Board of Governors of the Society of the New York Hospital, graciously granted me permission to quote excerpts from the Society Minutes generously copied for my use by his assistant, Miss Dora Mark.

The Library Committee Report the purchase of Doctor Hosack's Botanic Library for the Sum of Fifteen hundred Dollars and that they have given an order on the Treasurer for $1410, the Amount of the purchase Money, deducting Twelve Months Interest for prompt payment—the Books have all been delivered to the Librarian.[29]

The herbarium offered by Hosack on the purchase of his library was presented to the Hospital, as noted by the Governors, January 7, 1812, Minutes:

A Communication was received from Doctor Hosack presenting to the [New York] Hospital his Herbarium, or Collection of dried plants, together with a small Collection of Minerals, and a pair of paintings in Crayons of the Botanic Garden, which are accepted, and the Secretary is directed to return the thanks of the Board to Dr. Hosack for his attention to the Hospital.[30]

A manuscript reference to the plants in the herbarium, which accompanied Hosack's botanical library when the latter was purchased by the New York Hospital, was in a copy of Johann Andreas Murray, fourteenth edition of Linnaeus' *Systema Vegetabilium*, Göttingen, 1784.[31] Extensive inquiries have failed to locate this particular copy of Murray which might give information as to which plants were included in Hosack's Linnaean duplicates.

Whether the students, now that the herbarium had been brought nearer to them (Broadway between Anthony and Duane), consulted it, I have no way of knowing. I do know that Hosack considered a herbarium an important tool both in botanical and medical education and as an attending physician of New York Hospital he would, no doubt, have encouraged the students to take advantage of so valuable a library and herbarium.

The library was remembered by John Torrey * as having "botanical books, which or their equivalents, are now [1867] to be had by everyone, were then only to be found in the library of the New York Hospital."[32]

The botanical library of Dr. Hosack passed from the possession of the New York Hospital in 1898 to the New York Academy of Medicine, then on 43rd Street and in cramped quarters. This transfer was made for "certain economic reasons"[33] and was a generous gift of 23,000 volumes. By a gracious gesture on the part of the Academy, a large number of the botanical works, mostly from the library of David Hosack, were presented to the newly established New York Botanical Garden[34] (spiritual successor of the Elgin Botanic Garden).

HOSACK'S HERBARIUM: THE NEW-YORK HISTORICAL SOCIETY

In the year 1817 we again find a record of the herbarium. This time it came into prominence in connection with a renewed activity on the part of the New-York Historical Society. This society had been established in 1804, with David Hosack as one of the eleven founders who had met to organize the Society November 20, 1804. They had a notable list of members and took an active part in the celebration which was held in 1809 at the 200th anniversary of the discovery of the Isle of Manhattan by Captain Henry Hudson.

The City had at about this time (1816) set aside a vacant building which stood in the Court House Park on Chambers Street and which had formerly been an almshouse as headquarters for a number of learned and scientific societies. Six such organizations actually occupied quarters in this building which was designated as the New York Institution of Learned and Scientific Establishments but commonly known as the New York Institution.[35]

Of the six organizations, The New-York Historical Society was the most favored. The Society signed the lease for the apartment on May 13, 1816, "the yearly rent as one peppercorn, if lawfully demanded."[36]

The Historical Society held its first meeting in its new quarters on July 9, 1816, and continued to

[29] *Ibid.* The sale was noted by Hosack in the *Amer. Med. and Philos. Reg.* **2**: 462, 1812, and by the Society of the New York Hospital in a pamphlet of 74 pages, *An Account of the New York Hospital*, Section K, p. 72, 1811.

[30] Minutes, Board of Governors, New York Hospital. The Society no longer possesses the "pair of paintings in Crayons of the Botanic Garden."

[31] Society of the New York Hospital, An Acc't. of the New York Hospital, Section K, p. 72, 1811.

[32] Thurber, Geo., The Torrey Festival, *Amer. Naturalist* **2**: 41–47, 1868.

[33] I am indebted to Director Howard Craig and to the staff of the Rare Book Room of the New York Academy of Medicine for their courteous cooperation and for a photostatic copy from the unpublished minutes of the Academy of the Report of the Library Committee for the year 1898, dated January 5, 1899.

[34] Vail, Anna Murray, Botanical books of Dr. Hosack, *Jour. New York Bot. Gard.* **1**(2): 22–26, 1900.

[35] The 68th stanza of "Fanny," by Fitz-Green Halleck, 1821 records the action of New York City:

"To bless the hour the Corporation took it
Into their heads to give the rich in brains,
The worn-out mansions of the poor in pocket
Once 'the Old Almshouse' now a school of wisdom."

[36] Vail, R. W. G., Knickerbocker Birthday, 1954.

occupy the premises until 1832. Here they had four rooms, one for "sittings" of the Society, one for books, papers, and manuscripts, and two large rooms for cabinets to house the natural history collections. Encouraged by these enlarged quarters and a temporary relief from financial stringencies, the Society embarked on an enlarged program and established a series of lectures on subjects including zoology (S. L. Mitchill, lecturer), geology, mineralogy, chemistry; botany and vegetable physiology (D. Hosack, lecturer).

The same spirit of enthusiasm made it possible to begin collecting natural history specimens in earnest. Committees for this purpose were set up in all the above departments, cabinets were built for display of museum objects, printed appeals soliciting materials were issued and vigorously circulated, and for several years specimens poured in.[37]

The New-York Historical Society, concerned with promoting the Department of Natural Sciences, initiated steps on March 11, 1817, to procure the herbarium, then in possession of the New York Hospital, as follows:

> Whereas it was one of the original objects in the formation of this Society, to investigate and ascertain the botanical characters of the various medicinal and other plants of America, and of this State in particular, and as it is among the desiderata of this Society, to have a well arranged Cabinet of dried plants, as a standard with which to compare our native vegetable productions, and as such an Herbarium formed by a Member of this Institution,* is now in the possession of the Governors of the New York Hospital, and would materially contribute to the views of this Society,
>
> Resolved that a respectful application be made to the Governors of The New York Hospital, soliciting the use of that collection, as a basis upon which to erect a similar Cabinet in this Institution, also
>
> Resolved that the Governors of the Hospital be informed, that the aforesaid Hortus Siccus shall be carefully preserved, while it may be permitted to remain in the possession of this Society.
>
> * Dr. David Hosack.

The matter was later (April 8, 1817) reported on by the Committee of Botany and Vegetable Physiology; David Hosack, M.D., Chairman, Caspar Wistar Eddy, M.D. (nephew of Hosack's wife, a promising botanist who died in 1828, age twenty-seven), and John Eaton Le Conte.*[38]

> Pursuant to the resolutions of the Society, an application has been made to the Governors of the New York Hospital, soliciting the use of the Herbarium in their possession and to have the same placed in the apartments of the Historical Society, as a basis upon which to erect a similar cabinet in this Institution.
>
> The Committee have great pleasure in acknowledging the promptitude and liberality with which the Governors have complied with the request of this Society.
>
> The Committee also, with great satisfaction, observe that the Hortus Siccus (herbarium) referred to consists of several thousand plants in a very good state of preservation and well calculated to illustrate both the generic and specific characters of the plants which it contains. Some of these, too, they perceive have been preserved and designated by the hands of the illustrious Swede himself, being duplicates taken from the original collection now in the possession of Sir James Edward Smith, by whom they were presented to the chairman of this Committee [David Hosack].
>
> Others again were collected and preserved by the late celebrated Professor [Martin] Vahl of Copenhagen and are named by the hand of that "Prince of Botanists." Some of the original letters accompany the plants which he from time to time transmitted. Since his death, his successor, Professor Hornemann, and Mr. Hoffman Bang, of that city, have kindly continued their correspondence and contributions of dried plants.[39]
>
> Another valuable part of this herbarium, more especially consisting of the gramineous and herbaceous plants growing in the neighborhood of London has been communicated by the late Mr. William Curtis, the author of the "Flora Londinensis."
>
> Mr. James Dickson, the celebrated British cryptogamist, has also enriched this collection by a most valuable assemblage of the *Musci* and some of the other orders of the Cryptogamous class.
>
> The collection of the plants of Scotland, made by the President of the College of Physicians and Surgeons of the city, Dr. Samuel Bard, when a student at the University of Edinburgh, and for which he received the honorary medal conferred by Professor Hope, constitutes a part of our cabinet.
>
> Many of the plants of this and the neighboring states, preserved and arranged by Cadwallader Col-

[37] Hosack, David, An inaugural address delivered before the New-York Historical Society, 1820, *Essays on various aspects of medical sciences* 1: 213–226, 1824. Hosack stated that the New-York Hist. Soc. in 1816 was the only public institution in New York City "for the collection and classification" of the objects of natural science.

[38] MS. Minutes New-York Hist. Soc. Mr. Richard Vail, Director of the New-York Historical Society, courteously allowed me the privilege of examining the manuscript Minutes of the Society.

[39] I have not located the letters to Hosack. If Hosack's herbarium was destroyed as discussed later, the letters probably were also.

Through the courtesy of Dr. Joseph Ewan, I received copies of two letters in the Copenhagen Botanical Garden: David Hosack to Professor Vahl, March 1, 1804 and David Hosack to Hofman (Hoffman) Bang, June 6, 1816. I am indebted to Dr. Ewan for helpful suggestions and criticisms in the preparation of this paper.

den,* formerly Lieutenant Governor of New York, have also been recently added by his grandson, Cadwallader D. Colden, Esq., of this city.

Much also has been done in collecting the vegetable products of this island [Manhattan], more particularly those plants which grow in the vicinity of this city. The names of our learned Dr. Samuel L. Mitchill, the Professor of Natural History, Frederick Pursh, the author of the North American Flora, lately published, Mr. Andrew Michaux,* the historian of the American woods, Caspar Wistar Eddy, M.D., John Le Conte, Esq., Dr. Rafineau Alire Delile, the learned editor of the Flora of Egypt and who, while finishing his course of education at the Medical School of this city, industriously collected the native plants of our island, frequently appear as the contributors to this collection.

The Committee acknowledges the reception of a large collection of seeds from Monsieur Thouin, the Professor of Agriculture and Botany at the Jardin des Plantes of Paris, and another from our learned countryman, Mr. [Thomas] Jefferson,* lately received by him from European correspondents. The seeds will be conveyed to the Botanic Garden in the hands of the curator, Mr. Andrew Gentle.

Following the report, it was resolved:

That the apartments allotted to the Mineralogical Cabinet, and for the present unoccupied, be fitted up for the use of the Zoological and Botanical departments.

The Report on Botany and Vegetable Physiology, David Hosack, Chairman, as quoted above from the Minutes of the New-York Historical Society, was printed and given wide distribution both in this country and abroad as a circular sent out to other institutions and individuals who might feel inclined to cooperate with the Society in setting up an extensive collection in natural history, especially botany.

Although Hosack included Bard's herbarium in the Hortus Siccus in his report of April 8, it is separately mentioned at the June meeting of the Society. Doctor Hosack (Vice-President, presiding) read the following communication from Mitchill:

My dear sir N. York 20th June 1817

I have the pleasure to inform you that Doctor Samuel Bard's herbarium now lies on the Table of the Historical Society's cabinet. As it is an honour to our learned and venerable friend the author, so with a little repairing by the bookbinder it will last a long time to come.

Whilst I congratulate you on the acquisition of this valuable document I assure you also of my respectful salutations.

Professor Hosack Sam. L. Mitchill.[38]

Preparations for housing the herbarium were almost complete by May 6, 1817, when Hosack reported that the "Botanical cabinet would be ready for the reception of the Hortus Siccus received from the Governors of New York Hospital by their next meeting."

Upon its receipt, the Linnaean Herbarium was given a place of honor in the society's rooms at New York Institution and Dr. Hosack presented to the Society a head of Sir James Edward Smith, President of the Linnean Society of London. It was then:

Resolved, that the head of that distinguished naturalist and philosopher Sir James Edward Smith be placed over the Linnaean Herbarium in the apartment of this Society devoted to Natural History.

Tues. July 8, 1817.[39]

Dr. Hosack advised Sir James Smith that his bust had been placed in the New York Institution in a letter of July 25, 1817, now in the library of the Linnean Society of London.[41]

With his herbarium safely housed in the rooms of the New-York Historical Society and once again under his control, Hosack sought out his medical student, John Torrey, to arrange the newly acquired material for the New-York Society.

Although trained in medicine, chemistry, and geology, Torrey's major interest was botany. Born in New York in 1796, he was early associated with John Le Conte and David Hosack who in Torrey's youth was engaged in developing the Elgin Botanic Garden.

During the years 1811–1815, he received instruction from Professor Amos Eaton, prominent American botanist of the time, while Eaton was confined in the State Prison at Greenwich (later Greenwich Village) where John's father, William

[39] The New-York Hist. Soc. no longer possesses the "head" of Sir James E. Smith. A notice of this presentation appeared in the *Amer. Monthly Mag. and Critical Review* 1: 288, 1817:

"On motion of Dr. [John W.] Francis, resolved, that the bust of that distinguished naturalist and philosopher, Sir James Edward Smith be placed over the Linnaean herbarium * in the apartment of the Society devoted to natural history.

"* Through the kindness of the governors of the New York Hospital, the Historical Society has become possessed of the Herbarium formerly belonging to Dr. Hosack, and originally the property of Sir James Ed. Smith. This collection of dried plants, brought to this country by Dr. Hosack, is in excellent order, and is composed chiefly of duplicates taken from the original Linnaean Herbarium, formed by the great Swede himself."

[41] This letter and four others listed in the manuscript catalogue of the Linnean Society can be consulted on microfilm at the Library of the Amer. Philos. Soc.

Torrey, held the appointment of Fiscal Agent of the prison.

When approached by Hosack in April, 1818, to arrange the herbarium of the New-York Historical Society, Torrey wrote to Eaton:

> Hosack continues to be polite to me. I told you some time ago that I was going to arrange the Herb.[arium] of the Hist.[orical] Soc.[iety], but I gave it up—yesterday he pressed me very hard to undertake it & promised me all the duplicates it contains. He is going to commence his Bot[any] Lectures at the N[ew] Y[ork] Institution in a few days. He plasters me a great deal, but you know there is no kind of sincerity in him. He wants to propose me a memb[er] of the Hist.[orical] Soc[iety] & tells me he will let me jump into his shoes one of these days —asks me to breakfast and dine with him, & all such stuff. I don't like the man.[42]

The sentiments of John W. Francis, pupil and associate of Hosack, were quite different from those expressed by Torrey. Francis said,

> here [Elgin Garden] the learned Hosack Professor of Botany in Columbia College gave illustrations to his medical class and to many not within the circle of professional life. I shall never forget those earlier days of my juvenile studies when the loves and habits of plants and trees were first expounded by that lucid instructor and with what increased delight the treasures of the Jardin des Plantes of Paris, just arrived, through the kindness of Monsieur Thouin, were added to the great collection of exotics in this New York Garden.[43]

Eaton, older and less fiercely independent, replied to Torrey:

> You ought by all means to listen to Hosack, you are not bound to esteem everyone with whom you have intercourse. Do him justice for his attention to you and avail yourself of all the advantages he throws into your hands for the benefit of science and of yourself. You are not obliged to commit yourself to a patron, if you have not full confidence in him. Neither are you obliged to publish his faults, nor to express all your own impressions. Treat his attentions with respect. But still, *essentially* be the same John Torrey forever, and go on independently. There is a way of treating that subject precisely right; and do you search out that way. At any rate, do not slight his attentions![44]

Torrey did undertake the assignment. On May 15 he advised Eaton:

> I have arranged the herb[arium] of the Hist [orical] Soc[iety] as far as Syng[ensia] [Polygamia] Aequal [is] and I have got already about 600 species of plants that I had not seen before. I believe I told you this was the condition on which I undertook it—that I was to have all the duplicates it contained. I expect to get 200 spec[imens] of the Cryptogamia. Hosack has not begun to lecture yet & I doubt whether he ever will begin. He expected I was going to work for him but he does not know me yet. However I [am] civil, if not polite to him.[45]

The relationship between Hosack and Torrey by 1821 was friendly and cooperative. Hosack sent a packet of dried plants prepared by Torrey to his friend Smith and Smith advised Torrey, "I shall with my best thanks give a detail of all I have been able to discover concerning the plants about which you are in doubt.—Indeed I intend to notice everyone of your spec[ime][ns] whether doubtful or not."[46]

In 1822, Torrey agreed to give, with Hosack, a course of lectures on botany to students of medicine. "Hosack would give up entirely to me," he wrote, "but I am afraid to venture alone. If I succeed, I shall try another course in the fall by myself. We shall get rather more than 140 students at $10. each—half to come to me."[47]

These letters between John Torrey and Amos Eaton show that Torrey had a thorough and intimate knowledge of the specimens in the herbarium of the New-York Historical Society. He had sorted sheets, he had selected duplicates for his own collection. He must have seen and handled the Linnaean duplicates so highly regarded by Hosack and his colleagues. And yet, so far as I have been able to discover, nowhere does Torrey mention this unique collection.

HOSACK'S HERBARIUM AND THE LYCEUM OF NATURAL HISTORY OF THE CITY OF NEW YORK

The year 1817 saw the beginning of a new organization, The Lyceum of Natural History of New York. "A number of gentlemen, favourable to the cultivation of natural sciences" met on the twenty-ninth of January, 1817, at the Hall of the College of Physicians and Surgeons, Barclay Street, New York. The object of the meeting was "the consideration and adoption of measures for

[42] John Torrey to Amos Eaton, Albany, 1818, Apr. 25. Gratz Collection, Hist. Soc. of Penna.

[43] Francis, John W., *Old New York*, 30, 1857 (1865 ed.).

[44] Amos Eaton, Albany, to John Torrey, 1818, May 6. Library, New York Bot. Gard.

[45] John Torrey to Amos Eaton, 1818, May 15. New York State Library, Albany.

[46] James Edward Smith, Norwich, Eng., to John Torrey, 1821, Mar. 5. New York Bot. Gard.

[47] John Torrey to Amos Eaton, Troy, 1822, Mar. 23. Gratz Collection, Hist. Soc. of Penna.

instituting a Cabinet of Natural History in this city." [48] February 24, 1817, the group met under the name, "The Lyceum of Natural History of the City of New York." Dr. Barnhart, who wrote a history of the society, considered the College of Physicians and Surgeons the one institution in the city in 1817 which afforded a stimulus to the study of natural sciences, and Samuel L. Mitchill, Professor of Natural History of that college, the leader in forming a scientific society of the young men around him—mostly medical students (their average age, about twenty-seven years).

Mitchill was chosen President of the Lyceum and served to 1823; Caspar W. Eddy was First Vice-President and John Torrey, a Curator. This society and the Natural History Committee of the New-York Historical Society overlapped in interests.

Torrey, writing of the Lyceum to Amos Eaton, about 1821, said,

> We are now in possession of our room in the New York Institution. We have already a considerable collection of minerals, plants and insects. We meet once a week, have plenty of business and are in a great way. Resident members are mostly young men and very zealous. We have several good botanists among us. [Caspar Wistar] Eddy has proposed to me to publish with him a flora of 100 miles around New York. We have together about 1400 species, but I do not think myself competent to join in so important a work.[49]

The Lyceum and the Historical Society were in this period, 1817 to 1831, housed in the same building, the New York Institution.

The growing interest in the meetings and in the collections of the Lyceum of Natural History and their encroachment on subjects which the Historical Society set out to cover, led very shortly to a consideration of the desirability of readjusting the room space. Accordingly, the Lyceum addressed an inquiry to the Historical Society on November 29, 1819: "Whether and upon what terms the Historical Society would be willing to relinquish to the Lyceum of Natural History the rooms which the Historical Society at present occupies for its collections in Natural History." [48]

On April 10, 1820, the Minutes of the Lyceum record,

> The Rev. Mr. Schaeffer as Chairman of the Committee of the Historical Soc. applied to be informed whether the Lyceum would be willing to relinquish to the Historical Soc'y. the room at present occupied by them. On motion of Dr. Beck, Resolved, that provided the Historical Soc'y. surrender to the Lyceum two rooms at present occupied by its cabinet of natural history, the Lyceum will transfer all its right to the room in which it at present has its meetings subject to such conditions as may hereafter be determined upon.
>
> Wm. Cooper, Sec'y.[48]

The Historical Society, feeling that their Natural History Department was perhaps becoming too dominant, agreed to an arrangement as follows:

1. The room and cases occupied by the Lyceum to be surrendered to the Historical Society.
2. In addition to the said room and cases the Lyceum to pay for the aforementioned rooms and cases of the Historical Society the sum of $500 in five annual installments of $100 without interest.[50]

The two societies thus exchanged their allotment of space, one with the other. Thereafter, the Historical Society seems to have discontinued its activities in natural history, and the Lyceum carried on instead. However, the Historical Society continued its ownership of its natural history collections.

Although the rooms in the New York Institution had been exchanged and presumably the herbarium of the Historical Society was now in a room occupied by the Lyceum, the herbarium was not at this time owned by the Lyceum. Doubtless, Hosack, President of the Historical Society,[51] referred in his "Introductory Lecture at the College of Physicians and Surgeons" in 1825 to the Historical Society herbarium when he said,

> An Herbarium has been formed with great exertion and success, of a great number of medicinal plants. These actual specimens with their scientific names and the classes and orders to which they belong, are presented to the students that they may be put in a situation to acquire, in the lecture room, as much information as it is possible to lay before them. Particular pains have been bestowed upon the vegetable materia medica of our United States, the richest and

[48] Minutes Lyceum Nat. Hist.

[49] James, Joseph T., A letter from Dr. Torrey to Amos Eaton, *Bot. Gaz.* **8** (9): 289–291, 1883.

[50] Minutes Lyceum Nat. Hist., June 19, 1820, and Minutes New-York Hist. Soc., June 13, 1820.

[51] David Hosack served as President of the New-York Hist. Soc., 1820–1827. In 1820 he recommended that the Historical Society transfer its cabinet of natural history to the Lyceum of Natural History. He was elected an honorary member of the Lyceum in 1818 but never held office in the Society. From 1829 to his death in December, 1835, he was involved in developing his Hyde Park estate. March, 1835, he presented the Lyceum with a bust of Sir James Smith and June, 1835, a bust of Linnaeus (both busts have disappeared).

most important produced by any quarter of the globe.[52]

The years from 1824 to 1829 were financially difficult for the New-York Historical Society and its collections were in a state of confusion. After a series of conferences with a committee from the Lyceum, it was decided that the Natural History Collections of the Historical Society should be taken over by the Lyceum. Commenting on the condition of the herbarium of the Historical Society at the time of the transfer, the Lyceum Committee reported:

> The Hortus Siccus appears to have been very considerably extended by the zeal and industry of an intelligent member [John Torrey] of that Society [Lyceum of Natural History] and though the early volumes may not have been classed with the same care as bestowed on the latter collections, they cannot but form an object of much interest to the naturalist.
>
> Having fully investigated the matters referred to your committee, they beg leave respectfully to recommend that the property heretofore left in the rooms of the Lyceum, that is all mineralogical and geological specimens with all specimens and preparations of Natural History be presented to the Lyceum. [This would include the Hortus Siccus.]
>
> New York 12, Jan. 1829
>
> J. Delafield
> F. G. King
>
> To be communicated to the New-York Historical Society.

Of particular interest is the mention of "the early volumes" of the Hortus Siccus, referred to above, as it suggests that the plants were mounted in volumes and were not kept on loose sheets as is the custom in a herbarium today.

On February 23, 1829, Mr. Wm. Cooper as Chairman of the Lyceum Committee appointed to examine the state of affairs relative to a communication received sometime since from the Historical Society on the subject of articles said to have been left in charge of the Lyceum for safekeeping, reports as follows:

> That upon due examination your committee was satisfied that certain objects of natural history were so left as is shown set forth, that some were claimed by individuals about the time alluded to. . . . That others were in their nature perishable and have been discarded as unfit for our collections [i.e., skins of animals, skin of an Anaconda], and that some now remain in our collections in as good preservation as when first committed to the care of the Lyceum. The objects belonging to the Historical Society now in our museum are
>
> 1. an herbarium sold to the Historical Society for $120.00
> 2.–6. 5 joints columnar basalt, collection dried fishes, specimens of larvae. . . .

The Lyceum, in turn, took the following action:

> Whereas the Historical Society has generously presented to the Lyceum of Natural History the objects of Natural History as were left in rooms of the Lyceum of Natural History, the Lyceum of Natural History presents to the Historical Society documents late the property of the United States Military and Philosophical Society in their nature inappropriate to the Lyceum of Natural History.[18]

Thus, the herbarium of the New-York Historical Society, which included the Linnaean specimens originally the property of David Hosack, passed in 1829 into the possession of the Lyceum of Natural History.

The Hosack Herbarium became a valuable addition to a society which had in the years from 1817 to 1826 gathered a collection numbering several thousand specimens and counted among its members John Torrey, who served as President from

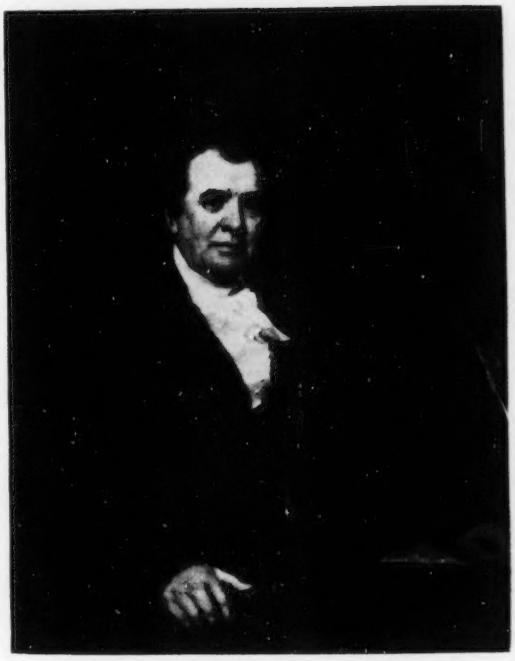

FIG. 3. Portrait of David Hosack by Samuel Lovett Waldo and William Jewett, 1831. Published by permission of the owner, The New York Botanical Garden. Courtesy of the Frick Art Reference Library.

[52] Hosack, David, Introductory Lecture, College Phys. and Surg., 1825.

Nov. 29, 1830

List of boxes, trunks, hampers &c containing the collections of the Lyceum packed up by Messrs Delafield & DeKay & deposited in basement room

No							
1	Square box	—	Annals of Lyceum	38	Oblong box	—	Minerals
2.	Chester	—	Plants	39	do	—	do
3	do	—	do	40	do	—	do
4	do	—	do	41	do	—	do
5	long box	—	Annals	42	do	—	do
6	square box	—	Plants	43	do	—	do
7	large square box	—	Comps Anatomy	44	do	—	do
8	square box	—	Plants	45	do	—	do
9	do	—	do	46	large sq box	—	Seeds & papers
10	square flat box	—	Annals papers Copperplates	47	oblong box	—	Minerals
11	oblong box	—	plants	48	do	—	do
12	small long box	—	Mineral duplicates	49	do	—	do
13	do square do	—	do	50	do	—	do
14	do flat do	—	fossil vegetables	51	do	—	do
15	square do do	—	do	52	small sq box	—	Cabinet Books
16	flat tinned box	—	do	54	oblong box	—	minerals
17	flat box	—	fossil invertebrae	55	do	—	Hungary minerals
18	oblong small	—	fossil	56	square box	—	Books misc[ellaneous]
19	do	—	do	57	oblong	—	do from Sabin & Kleinschmidt
20	sm. flat box	—	fossil	58	square box	—	Minerals
21	sq do do	—	do & Mins	59	do	—	Geol. Miscell
22	sq box	—	Mitchills Donation	60	large sq box	—	Seeds &c
23	do	—	do	61	small flat box	—	fossil. & minerals
24	very large box burst & put into 3 new ones Lin Herb & Am			62	long flat box	—	rocks
25	do do	—	Flora of U S & papers of business		Also the doors glasses &c belonging to		
26	flat sq box	—	Mitch. Donation		the cabinet		

FIG. 4. Portion of page from November 29, 1830 Minutes of the Lyceum of Natural History of the City of New York with item: "Box 24 very large box burst and put into 3 new ones Lin Herb and Am." Published by permission of Mrs. Eunice Miner, Executive Director of the New York Academy of Sciences.

1824 to 1826 and again in 1838, Joseph [José F.] Correa da Serra,* Constantine Samuel Rafinesque, Lewis David von Schweinitz,* [53] and Caspar Wistar Eddy, all well-known to botanists.

In November, 1830, the Lyceum was forced to move from the New York Institution to other quarters, and its collections were packed in boxes, trunks, hampers, etc., numbered from 1 to 62 and stored, as stated in their Minutes of November 29, in "certain rooms previously held by the Savings Bank." [54]

A catalogue of "boxes, trunks, hampers, etc." containing the collection of the Lyceum packed by Messrs. Delafield & Dekay, lists the contents of the various containers. The botanical material was as follows:

No. 2 chest—plants
No. 3 chest—plants
No. 4 chest—plants
No. 6 square box—plants
No. 8 square box—plants
No. 9 square box—plants
No. 11 oblong box—plants
No. 24 very large box burst and put into 3 new ones —Lin Herb and Am
No. 60 large square box seeds

The Minutes of the Lyceum do not state whether the three new boxes containing the "Lin Herb and Am" were numbered. The chests and boxes numbered (2, 3, 4, 6, 8, 9, and 11) merely labeled "plants" doubtless contained the balance of the herbarium, including the collections of Vahl, Hornemann, Curtis, Dickson, Bard and others mentioned in Hosack's report of 1811, as well as some of the collections of members of the Lyceum of Natural History, John Torrey, Eddy, von Schweinitz, and others.

DISAPPEARANCE OF HOSACK'S LINNAEAN HERBARIUM

The notation in the Minutes of the Lyceum for November 29, 1830, "No. 24 very large box burst and put into 3 new ones—Lin Herb and Am," is the last record I have found of Hosack's Linnaean Herbarium. No later reference is made to it in the Minutes of the Lyceum or in those of the New York Academy of Sciences, which succeeded the Lyceum in 1876, or in the correspondence or writings of Torrey, Gray or other botanists whose intimate associations with the Lyceum made them familiar with its collections, especially the herbarium. The history of the Lyceum after 1830 suggests the probable fate of the herbarium but does not document it.

In August, 1831, the collections and library of the Lyceum had been removed to new quarters in the New York Dispensary building which was located at the corner of White and Center Streets. The Lyceum occupied the upper or third story of the Dispensary and was relieved financially because the University of New York assumed the rent.

At the annual meeting of the Lyceum held at the New York Dispensary, February 27, 1832, the chairman of Curators reported:

> The greatest improvement has been made in the botanical department. The plants received for several years past have been suffering for want of proper care. These have been examined and systematically arranged. The whole are now preserved in a neat and convenient manner easy of reference and safe from injury. For this valuable service so long desired and so difficult to obtain the society is indebted to their vice-president, Mr. [Abraham] Halsey.
>
> Jos. Delafield—for the Curators. [55]

Although no reference is made here by the Curators to the Linnaean specimens, the inference is that all the collections listed as stored November, 1830, had been examined and were now, 1832, neatly and conveniently arranged for use.

The Lyceum members had long felt the need of a permanent home for their museum and the years 1832 to 1836 were largely devoted to this project. [56] A building was constructed at Nos. 561, 563, and 565 Broadway and a discourse on the opening of the new hall was delivered by J. W. Francis, December 28, 1836. The members held their first meeting in the building in May, 1836.

The Museum was accommodated in a room 50 by 70 feet occupying the front portion of the sec-

[53] Lewis David von Schweinitz is often referred to as Lewis De Schweinitz, Lewis D. Schweinitz, or de Schweinitz.

[54] The Savings Bank was located at 43 Chambers Street (Longworth's City Directory, 1830).

[55] Minutes Lyceum Nat. Hist. 1832 (Feb. 27). At this meeting a letter from Hosack was read. He transmitted to the Soc. a package of plants "selected and labelled by the late lamented Sir James E. Smith."

[56] A disastrous fire occurred in New York City, Dec. 16–17, 1835. The library and collections of the Lyceum housed in the New York Dispensary escaped destruction. David Hosack, however, had invested heavily in insurance companies and his financial loss was great. The fire was said by Harriet Martineau to have been a contributing cause of the stroke which caused his death on December 22, 1835 (Martineau, 1: 79). David Hosack is buried with his wife Mary, in Trinity Cemetery, Westerly Div., Broadway and 155th Street, New York City. His tombstone gives his birth date as 1796 (reversal of 1769).

ond and third stories. There was an apartment for a curator and space the Lyceum hoped to rent. Asa Gray,* twenty-six years of age, was appointed Curator, Superintendent, and Librarian, and took up his residence in the apartment allotted to the Curator. From 1830, when Gray first came into contact with John Torrey, the two men had been closely associated. Gray, an M.D., never practiced medicine but chose botany as a profession, in which he became a recognized leader.

On March 8, 1833, he had written to Lewis von Schweinitz, "I find my ardor for Botany increasing rapidly, and I mean to collect very extensively the ensuing spring and summer. Tho' not in practice I belong to the medical profession." [57]

The year 1834 found Gray in New York without adequate funds. He was enabled to pursue his botanical interest by acting as Torrey's assistant, living in the Torrey home. A letter from Gray to his father, November 21, 1834, states "The class at the Medical College is very small, so that I have no salary at present. . . . I spend my time at the medical college and at my home here at Dr. Torrey's and hold little intercourse with any except medical and scientific men." [58]

The hours at Dr. Torrey's were spent in Torrey's herbarium. Later in 1835 Gray moved from the Torrey home and boarded at 286 Bleeker Street, but he was "at Dr. Torrey's a part of almost every day." Here, no doubt, he heard much of the Lyceum Building, then under construction, as he confided to his father on November 17, 1835,

> . . . I hope to obtain the situation of Curator to the Lyceum of Natural History in the spring when their new building is finished. The duties of the situation will take up only a part of my time. I shall have under my charge the best scientific library and cabinet in the city, a couple of fine rooms to live in and a salary of about $300.00.[59]

On this date (November 17, 1835), Gray was not a member of the Lyceum. The Minutes record that he attended a meeting May 25, 1835, as a visitor and that a ballot was especially taken for his election as a resident member January 11, 1836.[48] Gray, thereupon, was chosen Curator and Librarian, a position he held with salary until March, 1837.[60] Here in his bachelor quarters he diligently employed the hours not occupied with his duties in his own studies. "A good part of last week," he wrote, "I was engaged with the snakes and toads, but of late I have attacked the Carices with as much vigor as the extreme heat would allow." [61] An appointment as Professor of Botany at the University of Michigan and an opportunity to go to Europe, made it necessary for Gray to abandon his quarters at the Lyceum Building in the spring of 1837. He told Torrey:

> I shall begin to pack up my herb[arium]. If I could now spare a little money for paper and folios the whole might remain deposited in the Herb [arium] case of the Lyceum. As to my heaps of duplicates, now chiefly confined to plants of this state, I now [know] not how you could confer a greater favor, just at present, than by accepting the whole lot and employing them in making up your sets of New York State plants. They are mostly good specimens.[62]

That Gray was well acquainted with the specimens in the Lyceum herbarium is clear. On April 17, 1837, "Dr. Gray presented [to the Lyceum] a collection of plants mostly from the states of New York and New Jersey and not contained in the Society Herbarium." [48]

The happy years while the Lyceum occupied its own building were all too few. The organization was made up largely of eager and ambitious young men, all busy with their own professions but intent on some phase of natural science. The membership was relatively small and expenses growing. The stores from which revenue was expected did not rent; times were difficult. On February 23, 1844, the Lyceum Building was sold at auction for $37,000. The home had to be sacrificed, but the library and collections were saved.[63]

The library was moved to Stuyvesant Institute[64] (University Medical College of the City of New York) at 659 Broadway and "some property (with Mr. [Charles] Cramer's[65] boxes) was removed to

[57] Shear, C. L., Letter of Asa Gray to Lewis D. de Schweinitz, *Rhodora* 7: 141–143, 1905.

[58] Gray, Jane Loring, *Letters of Asa Gray* 1: 47–48, 1893.

[59] *Ibid.*, 55–56.

[60] *Ibid.*, 20.

[61] Asa Gray, New York to John Torrey, Princeton, July 11, [1836], at the New York Bot. Gard.

[62] *Ibid.*, Mar. 31, [1837], at the New York Bot. Gard.

[63] Fairchild, H. L., *Hist. of New York Acad. of Sci.*, 44, 1887. The former property of the Lyceum sold for $200,000 about 1867.

[64] The Stuyvesant Institute of the City of New York was incorporated May 25, 1836, for the diffusion of useful knowledge by popular lectures, a library, a cabinet of natural history. The Medical College of New York University was begun at the Institute in 1841. The college purchased the building in 1842. The later home of the medical college on 14th Street was erected in 1851 (Stokes, *Iconogr.* 5: 1741, 1767, 1775, 1831).

[65] *Ibid.*, 90. Charles Cramer, a Russian mineralogist, had a private collection rich in Siberian minerals. He

the University and safely deposited in the basement of that building." [48] No reference is here made to the herbarium. It was, in all probability, moved there also though how it was stored is uncertain. It was not readily available, for the Curators reported on March 2, 1846, "of the condition of the herbarium we can say nothing as it is impossible to examine it."

At the meeting in May, 1848, the curators said, "We are doing less in Botany owing to the defection of some of our principal botanists. Gray has gone to Cambridge and Torrey no longer meets with us." However, on March 11, 1850, the report is, "Our large herbarium is in good condition. The Lyceum, at present, occupies a part of the medical college of the University of New York at Broadway under lease from the Professors." [48] This suggests that the herbarium at this time was available for inspection, if not for use.

Another change of location was forced upon the Lyceum, for the University Medical College (Stuyvesant Institute) sold the building at 659 Broadway and moved to its new edifice on 14th Street (Minutes refer to the location as 13th Street) in 1851. The Lyceum was offered a meeting room in the 14th Street building, but the requirements of the College left no room for the Library and Collections of the Lyceum. The Library was placed in the rooms of the Mercantile Library Association and most of the latter was packed in boxes and stored as reported by the Curators, April 14, 1851:

> At the residence of the President, 104 Franklin St., the Curators reported that all the property of the Society had been removed from the rooms, 659 Broadway, to the following places.
>
> The wet preparations, birds, mammalia, insects, crustacea, herbaria, the large specimen of Beryl and some large specimens of the Mastodon, the copper plates of the Annals, and the Table used by the First Congress, to the New York Medical College, 13th [14th] Street.
>
> The Conchological collection and all the cases and fixtures of the Cabinet to the cellar under B. Budd's drug store, No. — 2nd Avenue.
>
> The Minerals, Fossils, Geological specimens, Geological diagrams, the Library, 5 large tables, portions of the Giant's Causeway, and a number of large bones to a room on the 2nd Floor of the house occupied by the Butcher's Association, corner of 1st Avenue & 5th Street.
>
> The portrait of Dr. S. L. Mitchill to the office of Dr. J. G. Adams, No. 47 Amity St.[48]

was ordered back to Russia and his minerals were stored in the cellar of the Lyceum, later at the University. Eventually they were repacked and shipped to Cramer.

As far as I know, the collections stored at the University Medical College on 14th Street were not reclaimed before 1866. The curators' reports for the intervening years are short:

> March 20, 1854—no opportunity to examine the collections.
> March 20, 1855—basement room now occupied, leased for 2 years—collections stored.
> March 20, 1856—Books of Lyceum are on shelves in the Mercantile Library.
> March 4, 1861—The Collections of the Society are still packed and stored in the basement rooms and are suffering for want of care. The room is so closely packed it is impossible to get at them.
> March 3, 1862—Collections not liable to deteriorate by being boxed up are in safe cases and securely stored in basement room of college.

On May 21, 1866, at midnight, fire broke out in the building of the Academy of Music adjoining the Medical College on 14th Street. The *New York Herald* reported,

> Flames curled over and licked up the University Medical College which stood in the path on 14th Street. In 2 hours . . . the destruction of the building and the vast collections of the Lyceum of Natural History was complete. Perhaps the greatest loss of all for the interests of Science was the total destruction of the vast collections of the Lyceum of Natural History.[66]

In all probability, the herbarium of the Lyceum of Natural History, including the Hosack Herbarium with its nucleus of duplicate Linnaean specimens, was consumed in this fire.

There are no extant Minutes of the Lyceum for this period. Dr. Henry LeRoy Fairchild, writing twenty-one years later, stated, "Our scientific specimens were packed away in anticipation of a better day, which for the collections was never to come." [67]

Dr. John H. Barnhart wrote, "after the fire on the night of May 21, 1866 it [the Lyceum] was a society without collections." [68] Again there is no specific mention of the herbarium.

Addison Brown, on the other hand, refers to the "duplicates of the herbarium of Linnaeus, later given to the Lyceum of Natural History but since destroyed by fire." [21]

Is there any possibility, even the slightest, that the Linnaean specimens escaped the holocaust of 1866? Could the three new boxes into which

[66] *New York Herald*, May 23, 1866.

[67] Fairchild, H. L., *History of New York Academy of Science*, 106, 1887.

[68] Barnhart, J. H., First one hundred years of the New York Academy of Science, *Sci. Mo.* **5**: 463–475, 1917.

"The Lin Herb and Am" were placed in 1830 have been separated from the balance of the boxed collections and still remain forgotten in one of the many places to which the collections of the Lyceum were consigned in its checkered existence after 1830? I have considered and explored, in so far as I was able, various possibilities, but regret to report only negative results.

That items belonging to the Lyceum were deposited in various places and, perhaps, forgotten, is referred to by Fairchild in his *History of the New York Academy of Sciences* (1887). He mentions, for example, a table formerly part of the furniture used by the first Congress which was presented to the Lyceum of Natural History in 1837 and stored with "herbaria, birds, mammals" etc. at the New York Medical College (14th Street), April, 1851. This table was deposited with the New-York Historical Society in 1862 and was (according to Fairchild) still there in 1887.[69] Doubtless, in the removals of the Lyceum, many other articles may have been deposited for safekeeping with individuals or with other societies, of which we have no record and of which all knowledge has passed away.

In 1879 Dr. J. S. Newberry * informed the New York Academy of Sciences of the existence of forty-eight boxes of minerals and fossils, portions of the Museum of the Lyceum of Natural History, received from the storehouse of Sanderson Brothers and deposited in his rooms at the School of Mines, Columbia University.[70]

This information, together with knowledge of the many movings endured by the Lyceum of Natural History and later by the New York Academy of Sciences, encouraged me to believe that perhaps the Linnaean specimens still existed in some place "of which we have no record and of which all knowledge has passed away."

Clarence Lewis,[71] in 1947, was of the opinion that there were unpacked boxes stored at the New York Academy of Sciences, 2 East 63rd Street. Mrs. Eunice T. Miner, Executive Secretary of the Academy, has recently investigated their vaults at my request and advised me that there are no herbarium specimens there and no unpacked boxes. Mrs. Miner graciously made the Minute books of the Lyceum and of the Academy of Sciences available for my examination.

Mrs. Miner believed that Lyceum collections were still stored at Columbia University. Dr. Edwin Matzke, Professor of Botany, has been kind enough to make an exhaustive search there and concluded, "I think it most unlikely the [Linnaean] specimens will be found on the Columbia campus."

January, 1947, Dr. Henry Svenson, then of the Museum of Natural History, wrote Mr. Lewis in response to an inquiry. "There are no old botanical collections here," and Dr. Svenson has advised me that there are no specimens from the Linnaean Herbarium at the Brooklyn Botanic Garden. In his opinion, the Hosack collections are no longer extant.

No Linnaean specimens are at the New York Botanical Garden and no relics from the Lyceum of Natural History exist at The New-York Historical Society.

There is the possibility, however, that the Linnaean specimens accompanied the library of the Lyceum on its migrations, especially if they were mounted in bound volumes. The Committee of the New-York Historical Society referred in its report of January 12, 1829, to "the early volumes of the Hortus Siccus," and Dr. Bard's herbarium was evidently in a volume because mention was made in June, 1817, that his herbarium needed rebinding.

In 1831 the Cabinet and Library were housed in rooms of the New York Dispensary and in 1836 in the Lyceum Building on Broadway. In 1844 the Library was moved to Stuyvesant Institute, 659 Broadway. March 22, 1852, the books in boxes were moved to the upper floor of the University Medical College on 14th Street to a room set apart for Dr. Darling. In 1856 the Curators report that the books of the Lyceum are on shelves in the Mercantile Library. February, 1862, the Librarian says, "Books belonging to the Lyceum still occupy the shelves of the Mercantile Library, a safe and secure place in which to deposit our almost invaluable collections."[48]

February, 1876, the Lyceum changed its name to the New York Academy of Sciences and moved, with its Library, to Mott Memorial Hall, 64 Madison Avenue, where it remained until May 6,

[69] Fairchild, 105. The Assistant Curator of the New-York Historical Society has been unable to locate any records that the table was deposited with the Society. Neither the table nor any herbarium material is in the possession of the Society now.

[70] Minutes New York Acad. of Sci.

[71] The late Mr. Clarence Lewis, a member of the Board of Managers of the New York Botanical Garden, in preparing an address on "David Hosack and the Elgin Botanic Garden" had assembled notes relative to this subject which he most generously gave to me. I have consulted them in preparing this paper.

1878.[70] In 1878 the Library was moved to rooms of the American Museum of Natural History, 74th Street and 8th Avenue, and in September, 1886, it was again moved, this time to the fourth story of the Library Building of Columbia College, Madison Avenue and 49th Street, where it occupied a room jointly with the botanical books of the College Library and College Herbarium.

May 2, 1889, a committee of the Academy, on motion of Nathaniel Lord Britton,* was appointed to advise as to the proper disposition of its library.[70] Upon the removal of Columbia University to Morningside Heights, the Academy books were stored in the basement of Schermerhorn Hall. On advice of the Committee the bulk of the Library remained stored until April 6, 1903, when it was transferred to the American Museum of Natural History which later bought it. However, the botanical books which had been stored at Schermerhorn Hall were, in 1901, deposited in the Library of the New York Botanical Garden.[72]

If any volumes of the Lyceum herbarium accompanied the Library of the New York Academy of Sciences, they should be at the New York Botanical Garden or at the American Museum of Natural History. Inquiries at both these places were negative.

It seems impossible that any volumes of herbarium material or sheets of a herbarium could have been in the Academy's collection of books and have escaped Dr. Britton or Dr. Barnhart's notice. Dr. Britton was very closely connected with the Academy collection and would have been fully aware of the importance of Linnaean duplicates. Furthermore, the Lyceum Catalogue of books of 1830 and 1880 (books received from the rooms of the Academy) lists no herbarium volumes. So, the matter rests.

David Hosack, without doubt, brought to America a number of duplicate specimens from the Linnaean Herbarium, then the property of James Edward Smith. These formed the nucleus of a much larger herbarium assembled by and for Hosack which ultimately, after several transfers, became the property of the Lyceum of Natural History.

The last record of Hosack's Linnaean specimens is in 1830, a year after they came into the possession of the Lyceum of Natural History. If they were still a part of the herbarium of the Lyceum at the time of the fire in 1866, then for thirty-six years—from 1830 to 1866—no reference to them exists, so far as I have been able to determine.

On the other hand, if they were not included in the herbarium when the chairman of Curators reported in 1832 that it was "preserved in a neat and convenient manner, easy of reference and safe from injury," or if the three new boxes which contained the "Lin Herb and Am" had been lost or mislaid, then why did Torrey or Gray or some other members of the Lyceum with botanical interests or responsibility for the botanical collections not comment on their disappearance?[73]

John Torrey was intimately concerned with the herbarium of the Lyceum until 1830; he was President in 1838 and lived for seven years after the fire of 1866. Asa Gray was Torrey's assistant from 1832 to 1835 and Librarian, Curator and Superintendent of the Lyceum Building from 1836 to 1837. He must have appreciated the importance of Linnaean collections. It is almost unbelievable that a collection so greatly treasured by Hosack and honored when in the possession of the New-York Historical Society by having a bust of the donor, Sir James Edward Smith, placed above it, should have disappeared with no comment by those who knew of its existence and appreciated its value.

One can still hope, slight as that hope may be, that the specimens "preserved and designated by the hands of the illustrious Swede himself" and brought to America by David Hosack may have escaped destruction and may some day be discovered.

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[72] Minutes New York Acad. of Sci., Report of Librarian (Livingston Farrand *).

[73] Dr. Reed C. Rollins in a letter to me suggests that perhaps Torrey and Gray may not have appreciated the significance of Linnaean specimens because their approach was largely local. However, in view of the prominence given the Linnaean collections by the New-York Historical Society such a lack of appreciation would be difficult to understand.

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MOTIVES AND CONSEQUENCES OF ALEXANDER VON HUMBOLDT'S VISIT TO THE UNITED STATES (1804)

HELMUT DE TERRA

Adjunct Professor of the History of Science, Columbia University

(*Read November 12, 1959*)

In this year the centenary of Alexander von Humboldt's death has occasioned many gatherings of scientists in this country and abroad but nowhere have these been so significantly related to an historic shrine ideologically as symbolic as is Philadelphia's Independence Square. It was here, in Philosophical Hall, where Humboldt was welcomed, in May, 1804, by a group of distinguished members of the American Philosophical Society, and here also that the most fruitful and influential scientist of the last century manifested an ideologic commitment to American democracy which came to be uniquely productive for Humboldt's ramifying influences on the world of American learning and culture. Jefferson, Gallatin, Bache, Agassiz, and Prescott were among those who would benefit from Humboldt's friendship while others, like Emerson and Frémont, came to acknowledge the support Humboldt gave to the moral issues which stirred the American public immediately prior to the Civil War. Here on Philadelphia's historic soil was born that transatlantic bond which linked the active centers of American learning with the rapid growth of European science through the medium of a phenomenal scholar whom Darwin, among others, recognized as the most nearly omniscient of his time. Humboldt's only visit to the United States lasted but six weeks, yet its impact on American learning most likely exceeded that of any other foreign naturalist of that period.

The motives of this visit might at first glance appear to be related to Humboldt's American explorations as he himself indicated in a letter to James Madison in which he spoke of future travels in the American West. Astounding are the risks he took in coming here when we remember that he chose a detour on his return to Europe which involved a stormy passage from Havana to Philadelphia that almost ended in shipwreck. By running the British naval blockade, then extending to the east coast of this country, he recklessly gambled with fate. Anxious as Humboldt was to effect a speedy return to Europe after five years of travel in South and Middle America, such hazards underscore the importance he attached to his visit in the United States.

Upon his arrival in Philadelphia the motif of Humboldt's visit became immediately apparent when he wrote to President Jefferson: "I feel it my pleasant duty to present my respects and express my high admiration for your writings, your actions and the liberalism of your ideas which have inspired me from my earliest youth." The writer of these noble words was the explorer of the Orinoco, the conqueror of Chimborazo, the map maker and indefatigable observer—and the Prussian aristocrat whose family background differed so markedly from that of Jefferson. But inasmuch as both men had been invested with a reverence for reason, which the eighteenth-century philosophers had based on data supplied by science, it seems a foregone conclusion that Jefferson and Humboldt met on common ideologic ground no matter how different were their natures and family traditions. If the meeting with Jefferson in Washington turned out to be the moral climax of Humboldt's American travels with all its commitment to republicanism and the cause of American independence, such a motive can be understood only by inquiring about the mainsprings of Humboldt's liberalism.

Like his friends Cuvier and Arago, Humboldt was the child of eighteenth-century idealism, but unlike them he had received an education which brought the sixteen-year-old Alexander and his elder brother Wilhelm in direct contact with an active focus of enlightenment in his native city, Berlin. Up to that time the adolescent had dreamt of becoming an officer when, in 1785, his mother decided that he should be given a training in philosophy by adding Johann Jacob Engel, a pupil of Kant, to his other tutors. Engel was the author of a popular philosophy, a brilliant teacher at Berlin's finest school and a director of the National Theatre. More important still, he tutored the children of Moses Mendelssohn,[1] the intimate friend of Lessing and Kant, which

[1] M. Kayserling and H. Mendelssohn, *Moses Mendelssohn, sein Leben und Wirken*, 455 ff., Leipzig, 1888.

accounts for the instruction the Humboldt brothers received from Mendelssohn who was recognized as the most effective interpreter of moral philosophy and religion in Berlin.[2] Prior to their entering the University of Frankfurt on the Oder, the Humboldt brothers spent many a morning in the home of Mendelssohn whose influence Alexander remembered at the great age of eighty-eight. A leader of enlightenment, Mendelssohn, the composer's grandfather, had been immortalized for his moral leadership by Lessing in his drama *Nathan the Wise*. From him the Humboldts received the gospel of tolerance and reliance on man's capacity for self-education, for perfection, as Lessing had postulated in his inspiring writings. Once introduced to these exponents of classic idealism, Mendelssohn and Engel, the Humboldts soon found themselves at their most impressionable age in a circle of free-thinkers among whom was Dr. Marcus Herz, Kant's favorite pupil. At the age of twenty-one, his wife Henriette dazzled Alexander by her physical charms and intellectual brilliance. If her aging husband was able to inspire Alexander with his lectures on physics and his demonstrations of Franklin's experiments with electricity, it was his wife's salon which transmitted the essence of German idealism in regular gatherings devoted to discussions of the writings of Lessing, Herder, and Goethe. Whatever Alexander may have absorbed of Rousseau from his other tutors we can hardly fail to detect in this intimate circle of Henriette Herz the spark that kindled the kind of liberalism and humanism the Humboldt brothers were to manifest throughout their lives.

Between this encounter with the exponents of enlightenment and Humboldt's subsequent visits at Weimar falls the event of the French Revolution. As the electrifying news reached the Humboldt brothers at the University of Göttingen, the elder brother Wilhelm is reported to have taken the next mail coach to Paris. Alexander deferred his visit to the French capital by one year when, in the summer of 1790, he stood with his friend Georg Forster, the companion of Captain James Cook, on the Champs de Mars, spectators of the first public commemoration of the revolution. Unlike Forster, Alexander would not let himself be swept away, dedicated as he already was then to his scientific studies. In later life he repeatedly referred to the French Revolution as the event which determined his political views. His liberal convictions prompted him, at the age of seventy-nine, to lead the funeral procession for the victims of the Berlin uprising of 1848 and to risk time and again the charge of maintaining subversive political ideas.

In the years between 1794 and 1797, Humboldt paid several visits to Weimar and the University of Jena where he attended, in Goethe's company, a course in comparative anatomy. While scientific and philosophic subjects dominated his conversations with Goethe, Herder, and Schiller, one cannot help but surmise that Herder's humanistic essays, then in process of publication (1793–1797), left their impact on Alexander's mind occupied as he then was with practical philanthropic endeavors for improvement of the sordid conditions of mine labor. In fact, Herder's postulate that all human progress is grounded in humanitarian beliefs coincided perfectly with Humboldt's conviction of the humanitarian values of scientific knowledge.

Such ideologic beliefs were bound to be severely tried by Humboldt's experiences in the Spanish American colonies rampant with cruel oppression of native traditions and violation of human rights. Small wonder that the sensitive observer of such miseries was eager at the end of his travels to identify himself with the architect of American independence. More than a gesture, the visit was to prove his allegiance not only to the cause of American political emancipation but to a way of life, a new center of civilization which promised deliverance from an outmoded order of things. On purely ideologic grounds Humboldt might well have claimed citizenship from the first American republic if Paris had not seemed a more promising place for his scientific studies and publications. Precisely by choosing the French capital for his future home, Humboldt was able to develop his influential friendships with eminent Americans.

Among these was Albert Gallatin, first Secretary of the Treasury under Jefferson, whom Humboldt had met in that summer of 1804. Ten years later Gallatin conducted the negotiations with England which led to the Treaty of Ghent. The aid Humboldt rendered on behalf of a favorable reception of Gallatin's mission among England's allies is well known, and so is the friendship between him and the American envoy in Paris, in the years 1815 to 1823. The letters they exchanged then and after testify to an intimate friendship which happened to coincide with a

[2] Hanno Beck, *Gespräche Alexander von Humboldt's*, 188, 406, 407, 430, Berlin, Akademie Verlag, 1959.

phase of Humboldt's most intensive studies in which Gallatin took a lively interest: American antiquities and Indian languages. Through Humboldt he began to pursue his ethnologic studies which, following his retirement from a distinguished diplomatic career, led Gallatin to publish on American ethnology of which he came to be the founder.[3]

But American anthropology was to benefit also from Humboldt's archaeologic studies, notably from his descriptions of ancient monuments in Peru and Mexico and his collection of Mexican codices. These prompted Eduard Sehler to establish the science of American paleography subsequent to the explorations of the Maya civilization which had been inaugurated by John Lloyd Stephens and Frederick Catherwood. Stephen's mode of comparing Maya architecture and art with Egyptian antiquities touched on issues Humboldt had dealt with in his writings. When Stephens visited Humboldt in Berlin this problem of interrelationships between Pre-Columbian and Old World civilizations came up for discussion as did the concept of trans-Pacific migrations which Humboldt had previously formulated on the basis of ethnologic and somatologic analogies between certain American and Asiatic peoples. And if Prescott's historical works on Mexico and Peru succeeded so magnificently in portraying the fateful impact of the Spanish conquest on the Aztec and Inca empires, Humboldt's writings gave a new perspective to the indigenous civilizations of America. In view of such records it would appear that Humboldt's influence on American anthropology and historiology was greater than on any other field of scientific inquiry in the United States.

It was the singular twin role as naturalist and Americanist which continued to attract eminent explorers, scientists, educators, politicians, and writers from this country to the aging genius in Berlin. John Charles Frémont patterned his explorations of the American West after Humboldt by combining map-making with the objectives of a naturalist. Louis Agassiz felt drawn to the Amazon to supplement such zoologic studies as Humboldt had inaugurated on the Orinoco and afterwards to seek Humboldt's advice on matters of publication and research. Alexander D. Bache relied on Humboldt's intervention on behalf of the Coast and Geodetic Survey when Congress threatened to withdraw government support. Geomagnetic studies in this country were pursued with greater vigor following Humboldt's successful appeal to the Royal Society of London for the establishment of an international network of observation stations which came to be the first supra-national scientific organization. Let us remember also that the American Association for the Advancement of Science adopted the sectional organization which Humboldt first introduced at the Berlin meeting of the German naturalists in 1828. If the Astor Library in New York was able to obtain, among other items, the private library of the mathematician Gauss in Göttingen it was owing to Humboldt's interest in the development of American library resources. Whoever came from the United States to visit the aging nestor of European science was bound to hear him speak of his visit with Jefferson and the moral issue of slavery which threatened the disruption of the American republic.

At the age of eighty-seven Humboldt's concern over this issue made his liberal convictions erupt with undiminished force. If at thirty-five he had felt it his duty to pay his respects to the young republic so did the octogenarian feel morally obliged to enter the political fight over the abolition question. Many of his American visitors were treated to his passionate criticism of the negro problem in the southern states. What, he asked, could be expected from the new hopeful focus of civilization in America when freedom was denied to the victims of man's hideous crime, the slave traffic?[4] The moment Frémont's presidential campaign found fervent support in New England, sympathizers like Emerson, Ticknor, and Holmes added Humboldt's essay on slavery to their ideologic armor. Addressing himself in the *New York Herald* to the American public, Humboldt protested against the omission of this essay from the American edition of his work on Cuba, maintaining that he attached greater importance to his championship of freedom than to all his scientific works. To see liberty denied in a nation he so greatly admired seemed to him like betraying the best of human heritage. At that moment his obligations to science appeared to him subordinate to a deeper allegiance to human freedom. Without it no science and no nation can prosper. It is for this conviction rather than any other matter that Humboldt should be remembered here in Philadelphia.

[3] See Helmut de Terra, *Proc. Amer. Phil. Soc.* **102** (6): 560–589, 1958.

[4] See Hanno Beck, *loc. cit.*, 551.

ALEXANDER VON HUMBOLDT AND SPANISH AMERICA

ARTHUR P. WHITAKER

Professor of Latin American History, University of Pennsylvania

(*Read November 12, 1959*)

THIS one-hundredth anniversary of Alexander von Humboldt's death is being commemorated with special feeling in Spanish America. That is quite proper, for Spanish America owes much to Humboldt. He in his turn, however, was deeply indebted to Spanish America and its people. Though he spent somewhat less than five years among them and was only thirty-four years old when he left, never to return, his studies during this sojourn, aided by his companion Aimé Bonpland, not only won him international fame but also provided the materials for most of his voluminous disquisitions on man and nature in the next half century.[1] He could well have said of his Spanish American experience, in the words of Father William, "The muscular strength that it gave to my jaw has lasted the rest of my life." When this subsequent half century is added to the nearly five years actually spent by this great man in that vast area, one can appreciate the difficulty of summing up Humboldt and Spanish America in twenty minutes.

Perhaps the best way to begin is by noting the great and manifold timeliness of Humboldt's visit to Spanish America, which began in 1799 and ended in 1804. Politically it was timely because that was the eleventh hour of the old colonial regime: between 1810 and 1825 independence was won by all Spain's continental dominions, from Mexico to the southern tip of South America. It was timely for science too: eighteenth-century Europe had made great advances in the natural sciences and some in the social sciences, and Humboldt was now enabled to enrich and enlarge both by his South American experience. It has been said that as America was discovered by Columbus under the inspiration of the Renaissance, so it was rediscovered by Humboldt under the impact of the Enlightenment. This sweeping statement contains a large element of truth, but it must be qualified, for at this very time the philosophy of the Enlightenment was being superseded by new modes of thought, and Humboldt was an exponent of one of the chief of these, scientific romanticism, which he both fortified with data from, and applied to, Spanish America.[2] His visit there was no less timely for Humboldt himself. As we have seen, it gave him fame and the materials for most of his life's work. He would have distinguished himself anywhere, but it is difficult to believe that his achievements would have been equally great if he had chosen the alternatives of Egypt and India, as for a time he planned to do; they would certainly have been different—as different as Egypt and India are from "the equinoctial regions" of Spanish America where Humboldt did his great field work.

The story of the origin of his voyage has the next claim on our attention, for a number of reasons. It illustrates the unity of European culture at that time, and Spain's vital participation therein. It helps explain the favorable intellectual environment that Humboldt encountered in Spanish

[1] The recent discovery of Humboldt's original diaries of his various voyages shows that his publications would have been even more voluminous if he had not omitted a large part of the material in the diaries. As described in "Los manuscritos originales de los diarios de viaje de Alejandro de Humboldt," *Revista de Historia de América*, No. 47: 190-193, June, 1959, these were discovered by the historian Neftalí Zúñiga of Ecuador, consist of 13 manuscript volumes (mostly in German and French, though a small part is in Spanish), and contain almost all the source material for Humboldt's published works, as well as much information that he did not utilize. The unutilized portions include substantial data relating to Spanish America and the United States and his return voyage to Europe. The American Philosophical Society will aid in exploiting this collection through the agency of Dr. Helmut de Terra, who has already won an international reputation as an authority on Humboldt by his biography, *Humboldt: the life and times of Alexander von Humboldt, 1769–1859* (New York, Knopf, 1955), and other studies.

[2] Edmundo O'Gorman, *La idea del descubrimiento de América: Historia de esa interpretación y crítica de sus fundamentos*, Mexico City, Centro de Estudios Filosóficos, 1951, 242, 245, 251–255. This book deals almost as much with Humboldt as with Columbus. In my opinion O'Gorman's account of Humboldt and his times is the best part of this ingenious but highly controversial book. Humboldt's connection with the Columbus question is noted below in the text of the present article.

America and which contributed no little to the success of his mission. And it was of a kind to have gratified Humboldt himself by the support it gave to his belief in orderly progression without catastrophic breaks. The story of its origin will have to be summarized briefly here, and this can be done best by ordering it around two questions.

First, why did Humboldt want to go to Spanish America at all? A natural question, you may say, all things considered. The answer begins with his boyhood enthusiasm for stories of exploration, particularly that of the Spaniard Balboa, discoverer of the Pacific by way of Panama.[3] It continues with Humboldt's studies as a very young man at the Freiberg School of Mines in Saxony—a school then famous among physical scientists and frequented by able young Spaniards who were trained at their government's expense to become leaders of science in Spanish America as well as Spain.[4] Two of these, Fausto de Elhuyar and Andrés del Río, subsequently won great distinction by discovering new chemical elements, tungsten and vanadium, respectively; one of them, del Río, was a fellow student of Humboldt at Freiberg, and both of them were among his associates in Mexico in 1803.[5]

An additional impulse came from Humboldt's need for data from the tropics. For various reasons, the most promising area for his purpose lay in Spanish America; the most recent comprehensive descriptions of that part of the world by scientists of distinction—those by the Frenchman La Condamine and the Spaniards Jorge Juan and Antonio de Ulloa—were now half a century old and, besides, they left many of Humboldt's questions unanswered; so, he must go there himself. What he was looking for is indicated by a letter he wrote just before sailing for America. "I shall make collections of fossils and plants . . . [a] chemical analysis of the atmosphere, and . . . astronomical observations," he said, and continued, "My attention will be ever directed to observing the harmony among the forces of nature, to remarking the influence exerted by inanimate creation upon the vegetable and animal kingdoms."[6]

Nevertheless, from various sources, including Humboldt's autobiographical statement drawn up for the American Philosophical Society in July, 1804,[7] it appears that a voyage to Spanish America was only one of four travel plans that he entertained seriously, and was finally chosen because of a combination of personal considerations and the exigencies of war. When Humboldt, accompanied by Aimé Bonpland, went to Spain late in 1798, Egypt was his destination.[8] It was no accident or miracle, however, that, instead, he and Bonpland embarked for Spanish America under the auspices of the Spanish government. In doing so, Humboldt was only returning to a project of his own, which he had had in mind for at least two years and which was now rendered the most practicable and attractive of all by the cordial response it met with at Madrid.

Our second question is, why did the Spanish government respond so favorably to Humboldt? It not only gave him *carte blanche* for his observations and studies in all its American dominions, but also instructed its colonial officials to aid him in every way. To those unfamiliar with eighteenth-century Spain, such liberality on its government's

[3] V. W. von Hagen, *South America called them*, New York, Knopf, 1945, Part Two: Alexander von Humboldt, pp. 87 (a general statement) and 152 (quoting Humboldt on "the interest with which, as a boy I had dwelt on the narrative of the adventurous expedition of Vasco Núñez de Balboa").

[4] Arthur P. Whitaker, The Elhuyar mining missions and the Enlightenment, *Hispanic American Historical Review* **31** (4): 568–569 and 582, Nov., 1951. Humboldt's attendance at this school, and his meeting Andrés del Río there, are mentioned on p. 569. One of the principal attractions of the Freiberg School of Mines was the internationally famous geologist Abraham Gottlob Werner, whose presence gave the school a pre-eminence that was recognized even by Sir Charles Lyell, despite his fundamental disagreement with Werner.

[5] Arturo Arnáiz y Freg, *Andrés Manuel del Río*, 11–12, Mexico City, privately printed, 1936. Born in Madrid on November 10, 1764, del Río was sent to the Freiberg school in 1787 to study with Werner and met Humboldt during his residence there. He had just completed four years' study of medicine in Paris. On both occasions he was a *pensionado* of the Spanish government, i.e., in effect he held a traveling fellowship.

[6] Von Hagen, *op. cit.*, 99.

[7] This statement, which, though autobiographical, is written in the third person, was published in *Proc. Amer. Philos. Soc.* **102** (6): 566–572, 1958, where it forms the bulk of an article by Helmut de Terra, Studies of the documentation of Alexander von Humboldt, *ibid.*, 560–573.

[8] In the autobiographical statement cited in the preceding note, Humboldt describes himself as "continuing firm in his determination to go to Egypt" when he first arrived in Spain in 1799. His only explanation of his decision to visit Spanish America instead is that it was due to "a happy concurrence of circumstances" by which he obtained the Spanish government's permission to do so—"a permission which was granted with a liberality and frankness which was honorable to the Government & to a Philosophic age" (*loc. cit.*, 567–568). For a discussion of his other travel plans, see de Terra, *Humboldt*, 76–84.

part seems almost incredibly out of character, for the Prussian-born Humboldt was not only a foreigner but a Protestant, and every non-Spanish schoolboy thinks he knows that Spain excluded all foreigners from her American dominions and burned all Protestants at the stake.

The explanation of the Spanish government's generosity to Humboldt is in fact easy. Its chief elements fall into one of two categories: those relating to the general intellectual and political climate of eighteenth-century Spain, and those relating specifically to Humboldt's case. Only the barest summary of them can be given here.

Our sketch of the general elements must begin with the fact that Spain shared in the European Enlightenment of the eighteenth century and that the Enlightenment profoundly affected Spanish policy in certain ways which turned out to be helpful to Humboldt. If there are still any who doubt that the Enlightenment was a reality in Spain, they should inform themselves by reading two recent and richly documented studies of this subject, one by the distinguished French scholar Jean Sarrailh, Rector of the University of Paris, and the other by a young American scholar, Richard Herr of the University of California.[9] While the Spanish branch of the Enlightenment differed from its main stem north of the Pyrenees in important ways, the two nevertheless had many features in common and one of the chief of these was a deep interest in the promotion of science, both basic and applied. In Spain this interest flourished in official as well as private circles from the early part of the eighteenth century on. Since its only political bias was a pronounced regalism, it continued to flourish into the next century despite the general conservative reaction provoked by the French Revolution.

The interest of Spanish officialdom in promoting science was expressed in many ways. These included training young Spanish scientists in foreign institutions (such as the School of Mines at Freiberg, already mentioned), establishing or expanding scientific institutions in Spain and Spanish America, and sending scientific expeditions to America. It is a measure of Spain's interest that foreigners, and even Protestants, were used for these purposes. The scientific expeditions to Spanish America sent or authorized by Spain before Humboldt's time began in the 1730's with one to Ecuador led by the French academician Charles de la Condamine[10] and ended in the early 1790's with one sent to South America and the Pacific under the Italian-born Malaspina.[11] The leaders of another recent expedition to South America, the Spaniards Ruiz and Pavón, had returned to Spain and were consulted by Humboldt in Madrid in 1799.[12] Finally, in two of the most recent expeditions—mining missions sent to Mexico and Peru in 1788, and still there in 1799—the Spanish government entrusted some of the most responsible positions to men who, like Humboldt, were Germans and Protestants.[13] The general climate, therefore, was favorable to Humboldt's request for permission to do scientific work in Spanish America, and there were precedents for it.

If we look at the particular circumstances of Humboldt's case, there is again nothing mysterious or miraculous in the Spanish court's generosity to him. In the first place, he obtained his license for the voyage on the recommendation of the King of Saxony's ambassador to Spain, and that is easily understandable. Humboldt had studied in Saxony and had published a book about the flora of Freiberg for which he was rewarded with a gold medal by the Elector of Saxony, and he was already personally acquainted with the Saxon ambassador at Madrid. There were likewise long-standing ties between the courts of Saxony and Spain, which included cooperation in the field of science. For example, in 1788 the government at Dresden made the concession (remarkable for those times) of permitting Spain to recruit Saxon scientists and technicians for its mining missions to Peru and

[9] Jean Sarrailh, *L'Espagne éclairée de la seconde moitié du XVIII^e siècle*, Paris, Klinksieck, 1954; Richard Herr, *The eighteenth-century revolution in Spain*, Princeton, Princeton Univ. Press, 1958. See also Luis Sánchez Agesta, *El pensamiento político del despotismo ilustrado*, Madrid, Instituto de Estudios Políticos, 1953, and Arthur P. Whitaker, The intellectual history of eighteenth-century Spanish America, X Congresso Internazionale di Scienze Storiche, *Relazioni* **1**: 187–206, Rome, 1955.

[10] La Condamine's French group was accompanied by two young Spanish scientists, Jorge Juan and Antonio de Ulloa, who later wrote up their observations in two of the most widely read of all books about Spanish America in the late colonial period. See Arthur P. Whitaker, Antonio de Ulloa, *Hispanic American Hist. Rev.* **25** (2): 155–194, May, 1935.

[11] By the time of Humboldt's arrival in Spain, Malaspina's alleged political intrigues had landed him in jail at La Coruña, from which Humboldt sailed for America (Von Hagen, *op. cit.*, 98–99). For an account of Malaspina's expedition, see Alejandro Malaspina, *Viaje al Río de la Plata*, Buenos Aires, Editorial "La Facultad," 1938.

[12] Von Hagen, *op. cit.*, 93.

[13] Arthur P. Whitaker, *The Huancavelica Mercury Mine*, 67–68, Cambridge, Harvard Univ. Press, 1941.

Mexico.[14] In a sense, therefore, Spain only reciprocated this courtesy when she granted Humboldt's request on the recommendation of the Saxon envoy.

In the second place, Humboldt was aided by the fact that he was known to be *persona grata* to Spain's ally France, since he had recently been made a member of an official French expedition to the Pacific, the postponement of which had released him for his visit to Spain and Spanish America.[15] Finally, Humboldt was to pay his own expenses[16] and give a *quid pro quo* for his license, both by furnishing Spanish museums with botanical, geological, and zoological specimens collected in America and also by making reports to the Spanish governors in America.

Equipped with two Spanish passports (one from the Minister of Foreign Affairs, the other from the Council of the Indies), as well as a passport from his own Prussian government, Humboldt sailed with Bonpland from La Coruña, Spain, on June 5, 1799, and landed at Cumaná, on the coast of Venezuela, six weeks later (July 16). It would be idle to attempt even a summary narrative of Humboldt's life in these equinoctial regions, where he spent the next four years and ten months, until he sailed for Philadelphia from Havana on April 29, 1804.[17] I shall only try to indicate in a broad way the great range of his travels, observations, and studies, and of the subsequent works that grew out of them.[18]

Humboldt by-passed French Haiti and only touched (accidentally) upon the fringe of Portuguese Brazil, but in Spain's vast American dominions he visited all the major regions except Chile and the River Plate area. He spent the bulk of his time (three years and two months) in northern South America (Venezuela, Colombia, Ecuador, and Peru), one year in Mexico, nearly four months in Cuba, and about four months sailing from one Spanish American port to another. In political terms, he visited three of the four viceroyalties, or main administrative units. These included the two oldest, richest, and most populous, Mexico and Peru, which were also the leading exemplars of both the original Indian culture and the imported European culture. His travels familiarized him with all the rich assortment of geographical types in this region, from the hot and humid Caribbean coast, the insect-infested wilderness of the Orinoco and Amazon Valleys, and the sandy desert of the Peruvian coast, up to the high, temperate, and fertile intermont valleys of the Andes, and on beyond to their snow-capped peaks. He also ranged through all the gradations of this racially conglomerate society, in both its urban and rural sectors, from viceroys, archbishops, mineowners, *hacendados*, merchants, and intellectual leaders down through the mestizo artisans and Indian serfs to the Negro slaves and wild Indians of the untamed hinterland.

As for the scope of his observations, studies, and subsequent works, Horace's *Nihil humani* would have been too narrow for Humboldt, for nothing human, animal, vegetable, or mineral, animate or inanimate, in heaven or earth, escaped his eyes, heart, and pen. His main work, the thirty-volume *Voyage aux régions equinoxiales*, treats almost every then conceivable aspect of man and nature; even with the aid of Bonpland and others, it took more than a quarter of a century to complete. Its range is illustrated by his *Political Essay on New Spain* (1811), which is probably the most widely read of Humboldt's books today. Despite its modest title, this is

[14] Whitaker, article cited in note 4 above, pp. 581–584.

[15] Humboldt's autobiographical statement, cited in note 7, above, pp. 568–569. For a considerable time after his arrival in Spanish America, Humboldt still planned to join this expedition, in the expectation that it would sail for the Pacific via Cape Horn and the west coast of South America. It sailed via the Cape of Good Hope instead, with the result that Humboldt's residence in Spanish America was prolonged.

[16] De Terra, *Humboldt*, 198, n. 1, states that, according to Humboldt, "the total cost of his American travels was 33,500 thalers, a little over one third of his inheritance." The question is examined in some detail in Carlos Pereyra, *Humboldt en América*, 214–215, Madrid, Editorial América, [1917], where it is stated that an accounting showed that the net cost was 38,500 thalers, leaving Humboldt only 46,500 thalers. In any case he certainly spent a large part of his fortune on his travels in America, and he spent substantial additional sums on the publication of the results.

[17] The best chronology of Humboldt's travels in America is the one published by Helmut de Terra in *Proc. Amer. Philos. Soc.* **102** (6): 565–566, 1958.

[18] The following summary is drawn mainly from the works of de Terra, von Hagen, and Pereyra cited in preceding notes, and that of Stevens-Middleton cited below in note 21. Additional details will be found in the following: Nicolás García Samudio, *El viaje de Humboldt a América*, Bogotá, Editorial La Luz, 1939; Vito Alessio Robles, *Alejandro de Humboldt: su vida y su obra*, Mexico, Robredo, 1940; and Eduardo Roehl, *Viaje a las regiones equinociales del Nuevo Continente*, 5 v., Caracas, Escuela Técnica Industrial, Talleres de Artes Gráficas, 1941–1942.

much broader than "political" and much more substantial than an essay, in the usual sense of those terms. In fact, it is a study of the whole structure and functioning of Mexican society in relation to the physical environment. And Humboldt's interest in history, which runs through all his work, found its most concentrated expression in his *Examen critique*, a critical, documented study of the history of the discovery of America. All the foregoing contributed to Humboldt's culminating work, *Cosmos*.[19]

In *Cosmos*, Humboldt returned to the discoverer-of-America theme and (as before) awarded the palm to Columbus, despite the fact that Columbus was not the first European to find the New World, was not looking for it, and to the end asserted that what he had found was not a new world but an outlying part of Asia. This time Humboldt made the award to Columbus on philosophical grounds: progress comes from accumulated knowledge; the real discoverer is one who opens up new frontiers of knowledge; and in America Columbus performed this function by opening up the part that was strangest to Europeans, and in this sense newest and most distinctively American. By an interesting coincidence, that part happened to be Humboldt's own beloved equinoctial regions. As Edmundo O'Gorman remarks in his book on the idea of the discovery of America, the Columbus pictured in the pages of *Cosmos* bears a striking resemblance to that learned traveler and promoter of human progress, Alexander von Humboldt.[20]

The results that flowed from Humboldt's Spanish American sojourn were most important in the field of science, and have been summarized many times before.[21] Alone or with Bonpland, he added much to anthropology, botany, geography, and other disciplines. He humanized science by such exploits as his ascent of Chimborazo, the greatest recorded mountain-climbing feat up to that time; and he enlivened science with bits of quaint and curious lore such as electric eels and Peruvian *guano*, both of which had been known to the Indians from time immemorial, but like America itself, were new to European man. Finally, despite an occasional lapse, notably in the case of Andrés del Río, whose priority in the discovery of vanadium he obscured, he aided Spanish American scholars, and he also stimulated other scholars in many lands to further study in this vast field.[22]

Efforts have been made to blow Humboldt up into an important political figure, as a stimulator if not inciter of the Spanish American independence movement;[23] but they do not carry conviction. The prize exhibit in such efforts is the leading South American liberator, Simón Bolívar, who met Humboldt twice, first in Paris late in 1804, and then in Rome the next year. From what little we can learn of their conversations then, Humboldt was no firebrand on either occasion. It was Bolívar who raised the question of revolution, and Humboldt's chief contribution was the not very stimulating remark that, while Bolívar's country was probably ready for independence, "I do not see a leader for it." Subsequent contacts between the two men were few

[19] According to Pereyra, *op. cit.*, 9, *Cosmos* contains at least one hundred references to America in the first two volumes alone (there were four volumes in the first edition of 1845–1859) and these references are replete with "*un excelso lirismo*."

[20] O'Gorman, *op. cit.*, 266.

[21] The summary that I like best, because it is both concise and comprehensive, is the one in de Terra, *Humboldt*, 374–376, "Appendix A. A Brief Appraisal of Humboldt's Main Contributions to Knowledge." A handsome tribute to the Mexican aspects of Humboldt's geographical work, together with a very useful bibliography, is contained in a detailed study by Rayfred Lionel Stevens-Middleton, *La obra de Alexander von Humboldt en México, fundamento de la geografía moderna*, Mexico, D.F., Instituto Panamericano de Geografía e Historia, 1956. Published in collaboration with the Sociedad Mexicana de Geografía y Estadística; Publication No. 202, Instituto Panamericano de Geografía e Historia.

[22] Arnáiz y Freg, *op. cit.*, 30–36, concludes that Humboldt "betrayed" del Río in this matter. The question is too intricate to be discussed here, but note should be made of Arnáiz y Freg's brief statements to the effect that "North American chemists" (unnamed) took del Río's side in the controversy and that when del Río was in Philadelphia in 1833 a cousin of Humboldt's defended the latter on the ground that three boxes belonging to him were lost on his return to Europe and that the scientific papers entrusted to him by del Río might have been in one of those boxes.

[23] The literature of the *Humboldt-Bolívar-Frage* is reviewed in K. H. Panhorst, Simón Bolívar und Alexander von Humboldt, *Iberoamerikanisches Archiv*, Jahrgang 4: 35–40, 1930, and this is followed by the printed text and facsimile of a letter in French from Vicente Rocafuerte, a close associate of Bolívar, to Humboldt, dated London, December 17, 1824, referring to Bolívar's personal contact with Humboldt (in 1804–1805) and to the latter's steadying effect on Bolívar's character. The principal biographical studies of the two men published subsequently give restrained but definite support to the thesis that Humboldt was at least a stimulator of the independence movement. These are Gerhard Masur, *Simón Bolívar*, 50–52, Albuquerque, Univ. of New Mexico Press, 1948, and De Terra, *Humboldt*, 232–233.

and not very significant. Bolivar's voluminous collected letters for the next twenty-five years [24] contain only seven items to or about Humboldt, as compared with thirty-nine items to or about the Abbé de Pradt, a leading French publicist, who, unlike Humboldt, was an ardent supporter of the Spanish American patriot cause. And in a letter of 1825 listing the writers—some famous, others obscure—who had helped to shape his thought, Bolivar made no mention of Humboldt, though he had, years earlier, paid tribute to the "universality" of the latter's knowledge about Spanish America. What he missed in Humboldt was no doubt revolutionary fervor—a lack which was in fact real and is apparent in Humboldt's correspondence with Thomas Jefferson about the ferment in Spanish America. Added to that was the special inhibition of Humboldt's "gratitude" for the "protection and benevolence" for which he was indebted to the King of Spain, as he himself expressed it in dedicating his *Political Essay on New Spain* to that King, Charles IV.[25]

There is one respect, however, in which Humboldt's works on Spanish America had a political impact of considerable importance. While recognizing the Spanish Americans' faults, of which racism was one of the worst, he painted a picture of them that was on the whole favorable: Benjamin Franklin, he found, was known even in the wilds of the Orinoco; Bogotá, home of the "celebrated" scientist Mutis, was the "Athens of South America"; Quito was notable for "the amiability of its inhabitants and their happy turn for the arts"; the people of Lima were "distinguished by the vivacity of their genius and the liberality of their ideas"; Mexico City compared favorably with the capitals of Europe and had scientific institutions unsurpassed by any in the New World, including the United States; and the peasants of Mexico, the bulk of its population, were better off than most European peasants.

The very restraint of Humboldt's praise of Spanish America created confidence in its justice, so that his writings counteracted the widespread tendency in other lands (best illustrated in the United States by John Quincy Adams) to contemn Spanish Americans as well as Spaniards in terms of the long-familiar "Black Legend" of Spanish cruelty, greed, bigotry, and general cussedness. Humboldt helped to establish in the public mind of Europe and America a differentiation between Spaniards and Spanish Americans in favor of the latter, with two results: in general, it facilitated the acceptance of the new Spanish American states as members of the family of nations; and in the United States it fostered the growth of the Western Hemisphere idea [26] by making more plausible the basic assumption of that idea, that the United States and Latin America are bound together by shared ideals and ways of life.

[24] Vicente Lecuna, ed., *Cartas del Libertador* **1–10**, Caracas, Lit. y Tip. del Comercio, 1929–1930; **11**, New York, Colonial Press, 1948; there are exhaustive indexes in Vols. **10** and **11**. Of the seven items relating to Humboldt, only two are letters to him from Bolivar and both are letters of introduction. A third item (**11**: 191) is a letter from Humboldt to a third person, dated August 21, 1822, in which Humboldt says he had not written to Bolivar in fifteen years. The other four items (one of which, **3**: 264, is not indexed) are letters to other persons in the course of which more or less casual reference is made to Humboldt; the references are complimentary but none of them gives any support to the thesis that the latter incited or even stimulated the independence movement.

[25] Although the *Political Essay* was published in 1811, three years after Charles IV's abdication under pressure from Napoleon, Humboldt's introduction to it was written (or at least dated) in March, 1808, while Charles IV was still on the throne, and he let it stand.

[26] This idea is discussed in my paper, The origin of the Western Hemisphere idea, read at a meeting of the American Philosophical Society on April 23, 1954, and published in its *Proceedings* **98** (5): 323–326, 1954, and in my book, *The Western Hemisphere idea*, Ithaca, Cornell Univ. Press, 1954.

BASTARDS IN THE ROMAN ARISTOCRACY

SIR RONALD SYME

Camden Professor of Ancient History, University of Oxford

(*Read November 13, 1959*)

THE aristocracy of the Roman Republic, being not merely the upper order in society but the governing class, is patently one of the central subjects of historical study. It has in fact suffered undue neglect. The *nobiles* did not tell their own story. Warfare and politics, the struggle for office, honor and glory, that was their business, not literature; and, although the writing of history was reckoned proper occupation for a senator, the exponents tend to be *novi homines* (Cato, Sallust, Pollio).

Nor has modern investigation done enough to fill the gap. For two reasons. First, exact erudition went in preference to constitutional history and antiquities. Secondly, for the last century of the Republic at least, attention concentrated on a few conspicuous individuals: the Gracchi, Marius, Sulla, Pompeius, Caesar, Cicero. Hence biography, when the whole history of the governing class in its composition, recruitment and behavior was waiting to be written.

That theme has various aspects of appeal—the long duration of ancient houses, also their paucity. The Senate had three hundred members, six hundred after the ordinances of Sulla the Dictator. But the *nobiles*, that is to say, the descendants of consuls, who assert and generally obtain a monopoly of honors, are in the minority. Further, in contrast to aristocracies in other countries, the Roman nomenclature is simple and recognizable.

Evidence becomes abundant in the last generation of the Free State, but oligarchies have their *arcana*. Many of the activities of the Roman *nobilitas* evaded publicity or are only casually disclosed. Much therefore depends on guess or reconstruction.

For social history, one might be tempted to look for light and compensation in aristocracies elsewhere, in Europe from the Renaissance to the Napoleonic era. Useful parallels emerge, notably in England of the eighteenth century, which exhibits not only a resemblance to Rome but a kind of congeniality. And there is double profit.

A belief long prevalent in the modern world discovered at Rome a system of two opposed parties, *Optimates* and *Populares*. It derived support from an assumption about Tories and Whigs in English political life. But the party of Populares on close scrutiny tends to evaporate—though Optimates exist, solid and tangible, being the core of the oligarchy, the "factio paucorum." Similarly, Whigs and Tories dissolve or split up: instead, a number of aristocratic factions are discovered, with personalities counting for more than system or principle.

Comparative studies can sometimes help by furnishing negative clues—to types of behavior that were assiduously covered up or to phenomena that did not exist everywhere. The Roman noble was arrogant, conceited, and quarrelsome. But there is no trace of duelling, no hint that the practice was conceivable. In this respect, Rome was a true commonwealth of citizens, in spite of its class structure. Liberty and the laws regulated ambition and competition. The nobles had to conduct their feuds through oratory or intrigue.

It is not so easy to curb the commerce of the sexes. From the sixteenth to the eighteenth centuries the annals of England, France, Spain, and Italy proliferate with bastards. Monarchs and princes of the Church, the high nobility and the country gentry vie in emulation. And not much attempt to disguise or conceal. If anything, complacency or pride. Sons born out of wedlock acquire titles and estates; they marry into the best families; they occupy high positions in war and government.

Rome, however, offered no status or honor for the illegitimate. The class must have been fairly numerous. The *nobilis* was not in the habit of denying himself much, and opportunities abounded. It might be enough to mention slavery and concubinage. The freedwoman owed obligations to her *patronus*. Further, foreign travel will be taken into account, official entertainment or a generous interpretation of the privileges and fa-

cilities of *hospitium* (not always perhaps confined to providing slave girls). When Crassus went into hiding in Spain on the estate of a certain Paciaecus, his host furnished two girls for comfort and entertainment.

There is a singular dearth of evidence about aristocratic bastards. The subject might have been expected to appeal to the encyclopedic curiosity of Pliny. Book VII of his *Naturalis Historia* retails all manner of peculiarities concerning human life and behavior—examples of fecundity or longevity, people who never laughed or drank or belched, the irregular pregnancies of Vistilia (the lady of the six husbands), and so on. But no list of notable bastards. Further, he records certain persons of low degree who bore a close or comic resemblance to the illustrious. Thus two men just like Pompeius Magnus, or the deranged and ludicrous actor Burbuleius, who was the dead image of the consular Scribonius Curio. No imputations, however.

History exhibits, to be sure, a pair of pretenders in seasons of political crisis. In 100 B.C. a man called Equitius, claiming to be a son of the People's champion, Ti. Gracchus, secured election to the tribunate of the plebs, but was killed on December 10. Then, shortly after the assassination of Caesar, emerged C. Amatius, otherwise Herophilus (an eye-doctor), who passed himself off as a son of the younger Marius. He was quickly suppressed.

Furthermore, the compiler Valerius Maximus produces several cases of impersonation. Among them was a bogus P. Clodius—really a man called Trebellius Calca. Also an ostensible son of Q. Sertorius—an easy claim, for Sertorius spent a decade in Spain, but disproved by his wife. And further, an imposter alleging himself a son of Octavia, the sister of Augustus: he was sent to the galleys. These specimens do not amount to much. It is not easy to produce an authentic bastard anywhere, let alone the bastard of a *nobilis*.

Nor is illegitimacy much in evidence even for jest. As a curiosity all but isolated, may be mentioned a story about Augustus which a late writer, Macrobius, transmits. Observing a young man recently arrived from abroad who bore a striking resemblance to himself, the Emperor asked whether his mother had ever been in Rome. "No," replied the youth, "but my father was."

One of the criteria of a liberal society is the quality of its wit and humor. That was high indeed in the last epoch of the Republic, with notable practitioners, sophisticated as well as coarse. There was no law of libel. Language knew no curb or limit: electoral contests, prosecutions in the courts, altercation or invective in the Senate. In personal abuse of opponents, an orator would bring up all types of crime and depravity. They did not stop short of incest. Cicero in an electoral harangue of the year 64 asserted that Catilina's wife was in fact his own daughter. And, later, he alleged that P. Clodius had committed incest with his sisters. This, be it noted, from a *novus homo* to a *nobilis*. Not all accusations were seriously meant, or a cause for undying resentment. Who, for example, gave credence when Cicero alleged that virgins of the best families at Byzantium cast themselves down wells to escape the attentions of L. Piso? But there might be more damaging charges than sexual excess or divagations, namely municipal origin or sordid ancestors. The father of L. Piso had married a woman from Placentia. Piso's maternal grandfather (so Cicero suggests) was not really a citizen of that colony: he was an Insubrian Gaul from Mediolanum, or better, an immigrant from beyond the Alps.

The family of the Octavius whom Caesar adopted by his testament came from Velitrae, his father the first senator. The town of Aricia furnished the maternal stock—and Antonius in a speech in 44 spoke in deprecation of that origin. Unjustly, according to Cicero. Suetonius records an elaboration on that theme—Antonius alleged that the maternal great-grandfather of Octavius was an African, in trade at Aricia as a baker and seller of perfumes.

It will be observed that the allegations have to range back in time, and there is no direct imputation of illegitimacy anywhere. Nor, in personal attacks, do orators bother to assert that any of their adversaries have produced a string of bastards. The exception is Cicero, asserting that Antonius had children by Fadia, the daughter of a freedman. No trace is discoverable of this progeny.

So far the search for bastards of illustrious paternity is instructive perhaps on various counts, but not remunerative. How account for the almost total silence about the normal consequences of promiscuity? Various means of suppressing unwanted children must be allowed for—infanticide, abortion, and also the prevention of conception (about which matter there is little or nothing on

record). One factor, however, that is clear and decisive. At Rome it was not possible to confer legitimation through the subsequent marriage of the parents. Nor would the upper order have wished it so. Class structure and class feeling prevailed. The bastard followed the civil status of his mother. The mere transmission of blood had no sovereign or mystic value.

Illegitimate children of *nobiles* therefore lapsed and went to recruit the miscellaneous congeries of the Roman plebs. Here and there, no doubt, some freedman may have recalled by his physiognomy the dominant type of an aristocratic *gens;* and the clients whom the *nobiles* helped and promoted may sometimes have shared the ancestral blood. Socially they can seldom have been presentable enough to acquire status through adoption—the only means of legitimation.

The theme suggests and brings on a cognate enquiry: adultery and its fruits. The male of birth and standing did not have to restrict his enterprises to freedwomen, to the household of a client or guest-friend, to the professional purveyors of entertainment. In the upper order at least, women enjoyed a remarkable and general emancipation. Legal fictions, connivance or custom attenuated the ancient rigors. A married woman might even claim complete freedom to manage her own possessions, as is attested for Cicero's wife.

Marriages were contracted as a pledge of political alliance or a means of amassing property. It took little ceremony in this age to constitute a "iustum matrimonium," and the tie could be easily dissolved. Bigamy happens not to be registered as an offense in Roman legal writers, presumably because a fresh marriage was held to have automatically extinguished its predecessor.

The annals of the late Republic exhibit a whole cluster of great ladies, and some of them a force in politics. Sallust has delineated the type for all time. He interrupts his narration of the Catilinarian conspiracy to portray Sempronia, the wife of D. Junius Brutus (*cos. 77*). This woman was endowed with charm and intellectual gifts, but had no care for reputation. She chose her lovers where her fancy led; and, bold and energetic, she had committed many deeds of virile audacity.

The chronicle will not omit the gay sisters of P. Clodius, all three consigned in matrimony to persons of consequence—to Lucullus, to Marcius Rex, to Metellus Celer. There was also Fausta, the profligate daughter of Sulla the Dictator, whom her brother mocked for lack of discrimination in the choice of her lovers. Certain suspicions attach to Postumia, the wife of the jurist Ser. Sulpicius Rufus. Above all, Servilia, half-sister to Cato and mother of Marcus Brutus. In 63 B.C. this lady was Caesar's mistress. She was adept in political intrigue—and is found many years later (in June, 44 B.C.) undertaking to have a decree of the Senate modified.

The license which daughters of the *nobilitas* exploited in matrimony had sometimes to be endured for reasons of political expedience; and the Romans seem to have taken lightly those irregularities which (in the phrase of Gibbon) "according to the prejudice of every age reflected some discredit on the injured husband." Caesar, it is true, proclaimed that Caesar's wife must be above suspicion. Contemporaries may have thought him over-insistent on his "dignitas" when he divorced Pompeia because of her affair with P. Clodius. What he most objected to was perhaps the unfortunate publicity ensuing.

Some husbands connived or veiled their disappointments in discreet silence. However, there was no lack of resonant discords. Pompeius on his return from long absence in the eastern lands repudiated Mucia (his third wife) whose infidelities had been flagrant; and Lucullus had to discard in turn a Clodia and a Servilia, the former a sister of P. Clodius, the latter a half-sister of Cato.

The initiative did not always come from the husband. A letter of Cicero reports an engaging incident in the year 50. On the day when her husband was expected back from abroad, Valeria Polla announced her divorce: she was going to marry Decimus Brutus.

Divorce or laxity in wedlock, such was the position of privilege that noble ladies arrogated to themselves. Transgression being so common, and language so free, one looks for allegations that a man is not the true son of his ostensible father. And one looks in vain. Questions arise that permit no decisive answer.

In an oligarchic society, kinship and propinquity are known to everybody at the time. Some relationships, finding their patent expression in political compacts or feuds, escape the notice of historians in later ages. They may even baffle the mose erudite investigation. The scholarly Asconius had to confess disappointment that he could not ascertain who was the mother-in-law

of L. Piso. Similarly, a suspicious paternity may have been common knowledge among the nobility, accepted but not talked about. A governing class has various *arcana* of rule. One is the protection of its weaker members. Another is the decent suppression of uncomfortable truth.

Families tended to be small, indeed, to be kept small. To perpetuate the line, recourse could be had to adoption. An adopted son would normally come from a house at social parity, with previous congeniality from a political alliance. Actual kinship is often verifiable, or attractive for surmise. It may be that a noble sometimes retrieved in this way a son of his blood for the name and *gens*.

All in all, the absence of fact or imputation is a noteworthy phenomenon. The amours of Julius Caesar, at home and abroad, excited abundant comment. In this place it will not be relevant to discuss the paternity of Caesarion, the son of the Queen of Egypt. Nor need any words be wasted on the pretentious claim of a chieftain in Gaul, Julius Sabinus the Lingonian, that his grandfather was the fruit of illicit commerce with the proconsul. There is a list of Roman matrons whom Caesar seduced. Suetonius furnishes the names—Servilia, Mucia the wife of Pompeius, Tertulla the wife of Crassus, and so on. But nowhere in that age or in the next has scandal or research published the name of any son attributable to these adulteries with the matrons of Rome.

A legend emerged later, it is true—Brutus as Caesar's son. It has exercised a wide appeal in the modern age, being taken up and exploited by the writers of drama and novels, also by psychologists.

The evidence needs to be carefully scrutinized. Plutarch, recording that Brutus' life was spared after Pharsalia, notes the belief that he was Caesar's son. He goes on to relate Servilia's passion for Caesar, with the episode of 63 B.C. —Cato asking in the Senate what was the missive that had just been delivered to Caesar and being confronted with a love letter from his own sister. That is the account in Plutarch's *Brutus*. The notion, however, is extraneous to the main historical tradition as exhibited in his *Caesar* and his *Cato*. But it recurs, in another writer, Appian, being registered in the sequel of the assassination. A further particular may be added, the report in Suetonius that, according to some authorities, Caesar, stabbed by Brutus, exclaimed καὶ σὺ τέκνον. Suetonius refrains from comment or elucidation. The item and the words also occur in Cassius Duo.

Chronology is against Caesar's paternity. There are discrepancies in ancient estimates of the age of Brutus; but, since he was quaestor in 54, his birth should fall in 85. As for Caesar, the best evidence indicates that he was born in 100.

Servilia retained her influence with Caesar, and her son had a personal feud against Pompeius. Caesar was eager to attach Brutus, and other young *nobiles*, to his cause. That Brutus was rescued after Pharsalia is no surprise. Further, he was given a province to govern in 46, and Caesar intended that he should be consul with Cassius for colleague in 41.

In the tradition, Brutus tends to engross the credit for the conspiracy, obscuring Cassius, who began it. And the ingratitude of Brutus finds heavy emphasis—"for Brutus, as you know, was Caesar's angel." There was another Junius Brutus, namely Decimus, of a darker ingratitude, and no obvious reason for conspiring. It was none other than Decimus who on the Ides of March succeeded in persuading the Dictator to go to the Senate House. Of all the company, loyal Caesarians detested Decimus most bitterly. Antonius called him a "venefica."

Killed in 43, Decimus was eclipsed by the melancholy glory of Philippi, denied a place among the heroes and martyrs of the Republic. Equity demands that his role in the conspiracy be properly estimated. And it would be worth the effort to divine the motives that induced this Caesarian marshal to go in with Brutus and Cassius: the ancient accounts are silent.

None stood closer to Caesar (it should seem), and he had been away from Rome with hardly a break for a dozen years. D. Brutus is first discovered in 56, holding an important command (namely the force that subdued Aquitania), though he was not yet of senatorial rank; and in the next year he is signalized in the naval operations on the coast of Brittany. He might have arrived with his proconsul in 58. As for the Civil War, Decimus benefited by an especial indulgence from Caesar: he was not employed in military operations against fellow-citizens. When he returned to Rome in 45, he had been in charge of Gaul for three years. In 44 he was to proceed to the Cisalpina, with the consulship in 42 for sequel:

ahead of Brutus and Cassius, although their junior. That is not all. The last will and testament of the Dictator, drawn up in 45, named him among the residuary legatees; and, if a son were born to Caesar, Decimus would be the guardian.

The parent of Decimus was D. Junius Brutus, consul in 77, a dull inconspicuous person. Attention should go to the mother. In 63 the wife of the old consular was that Sempronia whom Sallust puts in high color and relief, though her only part in the Catilinarian affair was to lend her house for a meeting on one occasion. Why this anomalous prominence? A reason has been discovered and accorded wide credence: Sallust, a loyal partisan of Caesar, brings in Sempronia precisely because she was the mother of one of the assassins. A strong doubt must intervene. It is not certain that the historian was either a loyal Caesarian or hostile to D. Brutus.

There is something else. Sempronia, the wife of the consular, might not in fact be the mother of the tyrannicide, only his step-mother. Decimus bears a second *cognomen*, namely "Albinus." That is to say, he had been adopted by a Postumius Albinus, presumably the last of that ancient patrician house. No link of blood or marriage stands on record between Junii and Postumii. The adoption gives a hint, faint but not to be entirely neglected, that the mother of Decimus might be a Postumia.

The age of Decimus lacks direct attestation. His quaestorship would furnish a clue. He might have held that office in 50, when he was paying court to Valeria Polla, the sister of Valerius Triarius. If so, 81 is plausible for the date of his birth.

To conclude, with renewed emphasis on a paradoxical silence. No allegation of the time is extant to incriminate Caesar, or, for that matter, any adulterous nobleman, for having planted a son in another family. Well-grounded suspicions, perhaps, but nobody has given them voice and substance. However, if a son be sought for Caesar, it is Decimus, not Marcus. And, if Sempronia was the mother, so much the better.

THE HUMANITARIAN REFORM OF THE ENGLISH POOR LAWS FROM 1782 TO 1815 *

RAYMOND G. COWHERD

Department of History and Government, Lehigh University

ENGLAND has had a national policy of social welfare since the time of Queen Elizabeth I. Broad in scope and paternal in spirit, the Elizabethan Poor Law provided work for the unemployed, education for the children, relief for the impotent, and punishment for those able but unwilling to work.[1] The Poor Law thus embodied a social philosophy which assumed governmental responsibility for the working classes. However, with the disruption of royal authority during the seventeenth century, the parishes, which were the primary units of administration, restricted their obligations under the law to setting the poor to work, to binding pauper children as apprentices, to suppressing vagrancy, and to relieving the infirm.[2] Parochialism reached the nadir of social irresponsibility by the reform of 1723 which enabled the parishes to build Workhouses and to deny relief to anyone refusing to enter them, even though it might mean the separation of families and the abandonment of individual freedom. Many parishes capitulated their responsibilities under the law of 1723 by farming their poor to contractors. This deplorable mistreatment of the poor continued until the time of the younger William Pitt, when humanitarian reformers sought to restore the Elizabethan Poor Law to its original purity.[3]

The principal historians of the Old Poor Law, Sir George Nicholls, Dorothy Marshall, and Sidney and Beatrice Webb, have looked at the humanitarian reformers through the unsympathetic eyes of the natural law reformers. I have reversed this somewhat by viewing the history of the Old Poor Law from 1782 to 1815 from the perspective of the humanitarians. Nicholls, a defender of the New Poor Law of 1834, is hostile to the Old Poor Law and to the humanitarians who had reformed it. Dorothy Marshall, who emphasizes the early eighteenth century, gives little attention to the later decades. The Webbs, in their haste to reach the radical reforms of 1834, call the period from 1792 to 1832, "a generation of legislative failure" (8: 32). In contrast to their views, I have tried to understand the reforms of this period in terms of the patriotism and religion which motivated the humanitarians. William Pitt, who headed the Tory Government during most of the period under review, was greatly influenced by the humanitarianism of Sir George Rose and William Wilberforce.

To understand William Pitt's policy of social welfare, one must penetrate the confusion of terminology. Who were the poor people of Pitt's time? They were all people without property or profession and, therefore, dependent upon their labor for a living. The poor were not mere paupers (in the modern sense of the word) but all the working people.[4] Poverty meant the unfortunate condition of having to work for a living. Not until the nineteenth century did the term poverty come generally to mean dependence upon charity or public assistance for a living.

During the eighteenth century the natural law theory of labor prevailed. According to this doctrine, poverty was essential to the progress of civilization, for only under the spur of hunger would man bear the heavy burdens of progress and do all those irksome tasks which the rich

* I wish to thank the American Philosophical Society and the Lehigh University Institute of Research for the financial grants which made this study possible.

[1] Webb, Sidney and Beatrice, *English local government: English Poor Law history: Part I: the Old Poor Law* 7: 54, London, Macmillan, 1927. The statute, 43 Elizabeth I, c. 2, established the Old Poor Law system which lasted until 1834.

[2] Marshall, Dorothy, *The English poor in the eighteenth century*, 22, London, G. Routledge & Sons, 1926.

[3] Nicholls, Sir George, *A history of the English Poor Law* 2: 15, 2nd ed., London, 1898. The first edition of this famous history appeared in 1851.

[4] Colquhoun, Patrick, *A treatise on indigence*, 7, London, 1806. Nicholls distinguishes poverty and indigence: Poverty is "the state of one who in order to obtain a mere subsistence is forced to have recourse to labor" (2: 24). The indigent were those who received charity. Thomas Bernard, the secretary of the Society for Bettering the Condition of the Poor uses *the poor* interchangeably with *the working classes*. See his *Letter to the Bishop of Durham*, London, 1807.

wanted done. The natural law theorists deduced their labor theory from certain self-evident propositions about soil, plants, and people. Obviously belonging to and writing for a leisure class, the natural law theorists thought of themselves as the guardians of the nation's wealth and security; and to these ends they felt obliged to manage labor.[5]

Fortunately for the great masses of British people, there arose in opposition to the natural law reformers a group of benevolent men with a religious determination to ameliorate the harsh conditions of the working classes. The last decades of the eighteenth century, and especially the years of the French Wars, constitute a remarkable age of humanitarian reform. This was the period when William Wilberforce aroused humanitarian sentiment to abolish the slave trade, when John Howard and Elizabeth Fry strove to improve conditions in prisons, when Samuel Romilly agitated for softening of penal laws, when the elder Sir Robert Peel effected the first factory reform, and when Hannah More and Joseph Lancaster began a popular movement for the education of the working classes.[6] Motivated by religious zeal, the humanitarians sought to remove all those obstacles, ignorance, sloth, intemperance, and prodigality, which hindered the individual's salvation. They were alike in their desire to convert the lower classes to a new life of industry, frugality, honesty, and temperance and to bring to the upper classes a new sense of social responsibility commensurate with their wealth and privilege. During the critical period of the wars against France, the humanitarians, adding patriotism to their religious fervor, strove to improve moral conditions in time to merit the blessings of Providence upon Church, Crown, Aristocracy, and the whole superlative constitution.[7]

The humanitarian reform of the Poor Law was begun by Jonas Hanway, whose benevolent activities and sentimental writings created a new sympathy for the wretched conditions of the working people of London. Born in 1712, Jonas Hanway spent the first part of his mature life as a merchant, trading in Russia and the area of the Caspian Sea.[8] Upon his return to England in 1750, after having traveled extensively in the Near East, he gained distinction by writing an account of the British trade over the Caspian Sea. The wealth which he had acquired as a merchant, added to an inheritance, enabled him to retire from business and to devote the remaining thirty-six years of his life to uplifting the most neglected and wretched of London's poorer classes.

The more helpless and pitiable the people the more Hanway identified himself with them, with infants born in Workhouses, with orphan boys wandering homeless in London's dirty streets, with apprenticed pauper children bound to cruel masters, with prostitutes who had known no other employment—all of these wretches became the objects of his attention, became the "righteous causes" for which he conducted pious crusades. His seventy books and pamphlets on the most mournful subjects, shocking and appalling to the upper classes, were effective in creating a new social opinion and in obtaining financial support for the several benevolent institutions which he founded and promoted.[9]

As a result of Hanway's agitation against maintaining infants at Workhouses, where a majority died, Parliament enacted laws protecting the pauper infants of London. The law of 1761 required the parish clerk to keep a register of the names of pauper children under four years old, the names of the nurses who kept them, and the date of the death or discharge of such children.[10] When the parish registers revealed a very high death rate among babies born in the Workhouses of London, Hanway obtained a law in 1767 re-

[5] A famous statement of this doctrine is Bernard de Mandeville, *The fable of the bees* (1714): "The poor have nothing to stir them up but their wants which is wisdom to relieve but folly to cure." Adam Smith differed somewhat: "It is but equity, besides, that they who feed, clothe and lodge the whole body of people should have a share of the produce of their own labor as to be themselves tolerably well fed, clothed and lodged." *The wealth of nations* (Modern Library edition), 79.

[6] In my book, *The politics of English dissent*, I have analyzed the religious aspect of these humanitarian movements.

[7] Wilberforce, William, *A practical view of the prevailing religious system. . . .* London, 1797, and Gisborne, Thomas, *Enquiry into the duties of men in the higher and middle classes*, London, 1794, are the two most influential humanitarian works of this period. Both Wilberforce and Gisborne wished to revive a sense of responsibility among the upper classes as well as to lift morally the lower classes.

[8] Hutchins, John Harold, *Jonas Hanway, 1712–1786*, New York, Columbia University Press, 1940, is an able study of Hanway's career.

[9] Pugh, John, *Remarkable occurrences in the life of Jonas Hanway*, London, 1787.

[10] 2 Geo. III, c. 22. Also, Hanway, *Serious considerations on the salutary design of the act of Parliament for a regular, uniform register of the parish poor*, London, 1762.

quiring the metropolitan parishes to maintain their pauper children in the country until the age of six and then to pay some master to take them as apprentices. To assure better treatment for parish apprentices Hanway's Act required the parish to pay the master £4.2s., half the amount to be paid at the time of binding the child and the rest after three years. The same law placed parish apprentices on the level of "free" children by limiting the time of apprenticeship to seven years or the age of twenty-one instead of twenty-four.[11]

Of all the apprentices of London the most wretched and ill-treated were the chimney sweepers. These unwashed and half-clothed waifs of London, so urgently in need of a guardian, attracted Hanway's sympathetic attention, and his tracts on their behalf initiated the reforms for the better regulation of the master sweepers. But a business so essentially brutal could hardly be regulated and a class of masters so callous was scarcely amenable to moral admonition. Consequently, the "climbing boys" continued to be inadequately protected for another half-century, until the trade itself was abolished and machines substituted for small boys.[12]

When Hanway died in 1786, he left behind not only the institutions which stood as monuments to his humanitarianism but also scores of people zealous to carry on the reform of the Poor Law that he had initiated. Hanway's contemporary, Thomas Gilbert, labored assiduously for many years to ameliorate the conditions of the working classes. While Hanway's reforms pertained primarily to the children of the Metropolis, the provisions of the Gilbert Act of 1782 and the recommendations of his benevolent bill of 1787 extended the new humanitarianism to the whole of England. Although the Gilbert Act of 1782 was limited in its application and although the bill of 1787 was defeated in Parliament, Thomas Gilbert did much to establish a humanitarian Poor Law policy.[13]

A country gentleman of Stratfordshire, Thomas Gilbert was familiar with local problems so perplexing to the Justices of the Peace. His intimate knowledge of the affairs of rural parishes and his devotion to the improvement of their conditions made him an influential legislator in six successive Parliaments. He first directed his attention to the improvement of county roads by creating turnpike trusts. He also assisted the construction of canals and was one of the promoters of the Grand Trunk Canal. Because of Gilbert's fruitful activities, William Pitt, upon coming to office in 1784, appointed him Chairman of the Ways and Means Committee.[14]

Early in his career Thomas Gilbert sought to improve administration of the Poor Laws and to increase the benefits which the working classes derived from them. In order to achieve these ends, it was necessary to circumvent the inefficient parish system. Gilbert did so by creating new statutory authorities, similar to the turnpike trusts, to handle the specialized problems of employing the able-bodied and relieving the infirm. By combining a number of rural parishes under the new authority, he thought it would be possible to employ salaried officials instead of the unpaid Overseer. His bill of 1765 to incorporate parishes into Poor Law unions passed the House of Commons but was defeated in the Lords.[15]

Confronted with strong opposition, Gilbert patiently collected information to prove the need for drastic reform. Under his direction a census of expenditures and the number of persons receiving public assistance was taken in 1776.[16] Prepared with greater and more accurate information than anyone had possessed heretofore, Gilbert introduced in 1781 three Poor Law bills. Embodying the new humanitarian attitudes towards the working classes, his bills made provisions for three classes of people. His first concern was the unemployed. To meet the need of unemployment he proposed to facilitate the movement of workers from rural parishes to industrial towns and to create more jobs by public works.[17]

A second class of people—the rogues, vagabonds, and sturdy beggars—Gilbert regarded in a new light. Since the time of Elizabeth, the parish official had punished vagrancy, but Gilbert now tried to understand the cause of wandering.

[11] 7 Geo. III, c. 39. Also, Hanway, *An earnest appeal for mercy to the children of the poor particularly those belonging to the parishes within the bills of mortality . . .*, London, 1766.

[12] Phillips, George L., *England's climbing boys*, Cambridge, Mass., Harvard University Press, 1949.

[13] There is no adequate study of Thomas Gilbert's many benevolent activities. For my knowledge of him, I have depended mainly upon his four tracts on the Poor Law.

[14] *Gentleman's Magazine* (1798), **68** (2): 1090, 1146.

[15] Gilbert, Thomas, *Plan for the better relief and employment of the poor . . .*, 2, London, 1781. Hereafter cited as *Plan* (1781).

[16] *Gentleman's Magazine* (1798), **68** (2): 1146.

[17] Gilbert, *Plan* (1781), 4–7.

The lack of employment in the communities where the vagrants had their legal residence, he thought, was the primary cause of their leaving home. Desiring to return the wandering fathers and brothers to their families, he recommended that the King issue a royal proclamation setting aside for a time the penalties for vagrancy.[18] After the period of clemency had expired, however, the vagrant was to be sent, not to the Workhouse but to the House of Correction. When his bill became law in 1783, the counties were empowered to build Houses of Correction and to levy a rate for that purpose.[19] Thus Gilbert tried to separate criminals from the rest of the poor, leaving the Workhouses for the aged, sick, and infirm.

When proposing his Poor Law reforms in 1781, Gilbert was anticipating the end of the American War. To provide jobs for the disbanded army, he recommended the creation of a public authority to drain the wastes and reforest barren lands. As a promoter of roads and canals he was aware that public works were a means of employment, especially in rural areas where there was seasonal unemployment.[20]

One of Gilbert's primary objectives, as well as an objective of the humanitarians who followed him, was the repeal of that part of the Poor Law which required people to enter the Workhouse to obtain assistance. Based upon this law was the notorious contract system, a kind of forced labor, by which many parishes escaped from their responsibilities by farming their poor. He struck another blow at the contract system by shutting the door of the Workhouse on the able-bodied poor and leaving it as a residence for the infirm. He encouraged outdoor relief to all types of needy people so long as they had their own homes or relatives to care for them. He also exercised benevolence in prohibiting the removal of sick persons and of expectant mothers.[21]

That such comprehensive provisions of social welfare could not be carried out by many rural parishes Gilbert fully recognized. He therefore planned to create a new statutory authority to administer the law, leaving to the parish officials the duties only of levying and collecting the rates. Already a score or more of towns and cities had created, by the Local Acts of Parliament, the Guardians of the Poor, who hired salaried officials and supervised their work.[22]

The Gilbert Act of 1782, an omnibus law, comprehensive and benevolent in its provisions was limited in its application. In the first place, it did not apply to the towns and other places with incorporated Guardians of the Poor. In the second place, it was not compulsory; it merely enabled country gentlemen and other persons of wealth to initiate the union of several adjacent parishes for the better administration of the Poor Law.

Encouraged by the passage of the Act of 1782, Gilbert laid plans to extend more widely its benevolent provisions. Expecting to show that the union of parishes, under efficient management, had reduced expenditures, Gilbert obtained in 1786 a national census of Poor Law expenditures for the years 1783 to 1785.[23] With evidence of the reduced expenditures in those Hundreds of Suffolk and Norfolk that had united their parishes, Gilbert went before Parliament with a plan to establish county-wide statutory authorities.[24] However, the proposed authorities, by circumventing the Magistrates and Justices of the Peace, would have reduced the political influence of both the Anglican clergy and the country gentlemen. Consequently, when Gilbert's bill reached its second reading on April 17, 1788, the House of Commons summarily rejected it. Speaking on behalf of the clergy and gentlemen who served as Magistrates in many places, William Young declared: "The bill would reduce the Magistrates in being throughout England to an insignificant and unworthy situation by creating a board of commissioners paramount in power. . . ."[25]

Outside Parliament the principal opponent of Gilbert's humanitarian reforms was the Reverend Joseph Townsend. This Anglican clergyman, who was keenly interested in geology and a member

[18] *Ibid.*, 18.

[19] 23 Geo. III, c. 51.

[20] Gilbert, *Plan* (1781), 18.

[21] 22 Geo. III, c. 83. See S. and B. Webb, *op. cit.* 7: 151, and Marshall, *op. cit.*, 159, for expositions of the law. The Poor Law historians recognize the humanitarianism of the Gilbert Act. The Webbs call it "the most influential for both good and evil" of all the scores of statutes between 1601 and 1834 (7: 171). But they later say "for years it scarcely worked at all." Under the Act of 1782, 67 unions were formed, comprising 924 parishes (7: 275).

[22] Gilbert was familiar with the Poor Law Unions established in Norfolk and Suffolk. The Webbs have treated these in their volume, *Statutory authorities* 4: 121–137.

[23] 26 Geo. III, c. 56.

[24] Gilbert, Thomas, *Considerations on the bills for the better relief and employment of the poor . . . intended to be offered to Parliament this session*, London, 1787.

[25] *Parliamentary history* 26: 266.

of the Royal Society, produced a lengthy essay on the Poor Laws in 1785 and another, three years later, condemning Gilbert's bill of 1787. For Townsend, poverty was both necessary and inevitable. "It seems to be a law of nature," he said, "that the poor should be to a certain degree improvident that there may always be some to fulfill the most servile, the most sordid, and the most ignoble offices in the community. The sum of human happiness is thereby increased. . . ." Poverty, he thought was the necessary spur also for the soldier and the sailor; otherwise they would not risk their lives. Since in the progress of society some must want, Townsend thought it natural that "the prodigal, slothful, and vicious should suffer rather than the provident, diligent, and virtuous." [26]

The natural law assumption that poverty was the necessary motive for labor led Townsend to conclude that voluntary charity should be substituted for compulsory Poor Laws. "To promote industry and economy," he declared, "it is necessary that the relief given to the poor be limited and precarious." Townsend's objections to Gilbert's benevolent reforms stemmed from his natural law assumptions. Whereas Gilbert wished to organize the generosity of "gentlemen and men of substance" into a more benevolent system of relief, Townsend preferred to defend the parsimony of the Overseers and to use the Workhouse test as a shield against increasing expenses.

Like other natural law reformers, Townsend derived his social and political philosophy from a few obvious facts about soil, climate, food, and population. The limitations of soil and climate, he thought, determined also the greatness of a nation's wealth and the size of its population. A country's population, obviously, could never advance beyond its food supply. "If natural remedies are rejected," he admonished, "it remains only for the poor to expose their children, as is the horrid practice adopted by the richest country of the world [China]." [27] Notwithstanding the Poor Laws, there were effective checks, Townsend thought, on the growth of population in England. These were the lack of cottages and the Workhouse test. Although he did not advocate the immediate abolition of the Poor Laws, he defended the Workhouse test and the pulling down of cottages as necessary checks on an excessive population.[28]

Townsend's natural law arguments and the defeat of Gilbert's bill in 1787 delayed but did not prevent the humanitarian reform of the Poor Laws. Upon the retirement of Gilbert as the Parliamentary advocate of Poor Law reform, Sir George Rose took up the work of improving the conditions of the working classes and carried it forward until his death in 1818.[29]

Born in 1744, George Rose spent several years of his youth in the Royal Navy before beginning his career as a politician and civil servant. In 1772 he was appointed the Keeper of Records at Westminster with the prodigious task of supervising the publication of the Journals and Rolls of Parliament. Demonstrating in this project his capacity to handle a vast complex body of information, he was appointed Secretary to the Treasury with the duty of revising and consolidating the customs in order to prevent smuggling. In this office he served so efficiently that be continued to hold it from 1784 to Pitt's resignation in 1801. Upon Pitt's return to office in 1804, he appointed Rose Vice-President of the Board of Trade and Joint-Paymaster General of the Forces. Despite Rose's lack of joviality, Pitt highly esteemed him for his tact and thoroughness.[30] For sixteen years Rose kept a careful hand on the purse strings. As a man of business he was indefatigable, early and late, while others enjoyed pleasure. His assiduousness in matters of commerce and finance made him indispensable not only to Pitt but to other Tory Governments. His ability to assimilate vast quantities of statistical information enabled him to stand in Parliament as an authority on budgetary matters at a time when the nation had to marshal its resources in waging war against France.[31]

Sir George Rose's benevolent attitude toward the working classes led him to espouse the reform of the Poor Laws. The first measure which he proposed—subsequently identified as the George Rose Act—was designed to encourage and protect Friendly Societies. These benefit clubs had

[26] Townsend, Joseph, *Dissertation on the poor laws*, 35, London, 1785.

[27] *Ibid.*, 51.

[28] Townsend, Joseph, *Observations on various plans offered to the public for the relief of the poor*, 4–10, London, 1788.

[29] *Gentleman's Magazine* (1819), **89** (1): 529.

[30] Rose, J. Holland, *William Pitt and national revival*, 286, London, George Bell, 191.

[31] Vernon-Harcourt, G. F., ed., *The diaries and correspondence of the Right Hon. George Rose* **2**: 505–518, London, 1860.

long existed among the working classes to provide fellowship and some financial assistance in times of emergency. As the practice of life insurance spread among the upper classes, several benevolent persons developed plans to bring group security within the reach of working people. As early as 1772 a bill providing life annuities for the poor passed the House of Commons but was rejected by the Lords. The several plans for life insurance were proposed as a means of reducing the Poor Rates as well as a benefit to the working classes. In 1787 John Rolle, when proposing in the House of Commons his plan for a universal benefit society, said "it would reduce expenditures for the poor, relieve distresses, give a spur to industry, and encourage population." [32] Rolle's bill failed to pass the Commons because it attempted too much. Although Gilbert had supported the bill when it was first introduced, he abandoned it "after much deliberation and conversation with many members of the House . . . from an apprehension that it could not be executed on so hazardous a scale." [33]

The George Rose Act of 1793, more modest in its conception than the Rolle plan, provided protection and encouragement for Friendly Societies in the raising of funds voluntarily for the mutual relief and maintenance of members in sickness, old age, and infirmity.[34] The new law placed the Societies under the guardianship of the Justices of the Peace and endowed them with the power to sue and be sued. It freed them from the stamp tax and other legal fees imposed by the courts. Rose proposed his reform with the benevolent intention of improving the conditions of the working classes and with the prudent interest of reducing Poor Law expenditures.[35]

During the rest of his life, George Rose showed solicitude for the Friendly Societies. When he persuaded Parliament to obtain the Poor Law Returns in 1803, he inquired about the number of Societies and their total membership. Throughout England and Wales there were 9,672 Societies with a membership of 704,350;[36] and by 1815 the membership had grown to 925,264.[37] By the end of the French Wars the Friendly Societies had proven their usefulness in ways not anticipated by Rose. When other types of political and social organizations were denied to the working classes by the Anti-Combination Acts, the Friendly Societies remained open to them as a means of sharing their miseries and articulating their grievances. Alarmed by the growth of the Societies, Parliament appointed in 1825 a committee to investigate their activities and the committee confirmed the suspicion that the Friendly Societies had facilitated combinations to raise wages.[38]

While Sir George Rose did not intend to assist the formation of labor unions, he did wish to increase the mobility of labor. Like other humanitarians, he desired to help the poor to help themselves in becoming sober, frugal, and industrious. He was keenly aware of, and optimistic over, the rapid expansion of industry and the increasing demand for labor in the thriving factory towns.[39] To encourage the workers to move to these opportunities and to give them greater security in their new residences, he provided in his law that no member of a Friendly Society should be removed until he became actually chargeable. Two years later this provision of the law was extended beyond the Friendly Societies to all the working classes so that parish officials could remove no one until he became dependent upon the parish for relief.[40]

By changing the Law of Settlement, which had enabled the parishes to remove poor persons to their place of legal residence, Sir George Rose had gone far in eliminating a perennial criticism of the Poor Law. Since the time of Adam Smith the natural law theorists had objected to the Laws of Settlement and Removal on the grounds that they immobilized the working classes.[41] In addition to increasing the migration of labor to places of employment, Rose and the humanitarian reformers wished to reduce the expenditure of money on litigation and to prevent the removal of sick persons and pregnant women. Subsequent laws were enacted forbidding the removal

[32] *Parliamentary history* **26**: 1062.

[33] *Ibid.*, 1280.

[34] 33 Geo. III, c. 54.

[35] Rose, George, *Observations on the act for the relief and encouragement of friendly societies*, 10, London, 1794.

[36] *Abstract of returns relative to the expense and maintenance of the poor*, 715, London, 1804.

[37] *Abstract of returns relative to the expense and maintenance of the poor*, 629, London, 1818.

[38] *Report from the select committee on the laws respecting friendly societies*, 8, London, 1825.

[39] Vernon-Harcourt, *op. cit.* 2: 525.

[40] 35 Geo. III, c. 101. This law partly circumvented the old statute, 13 and 14 Car. II, c. 12, which had empowered the parishes to remove persons lacking a lawful residence.

[41] Smith, Adam, *op. cit.*, 135. Howlett, *op. cit.*, 12, did not think that the Laws of Settlement had immobilized labor.

of any pregnant woman or any family with a sick member.[42]

The laws to improve the mobility of labor were enacted in conjunction with the increase in outdoor casual relief. By providing casual relief the Friendly Societies had prevented some of their members from becoming chargeable. The law of 1795 commanded the Justices of the Peace to grant casual relief to everybody in time of sickness or "temporary distress."[43] Previously, the Gilbert Act of 1782 had repealed the Workhouse test in all those parishes which had united under its provisions. The law of 1795 extended this benevolent provision of the Gilbert Act to all parishes by repealing the law requiring the poor to enter Workhouses to obtain assistance. The preamble of the new law declared the Workhouse Act (9 Geo. I, c. 7) to be "inconvenient and oppressive inasmuch as it often prevents an industrious person from receiving such occasional relief as is best suited to the peculiar case of such poor persons."[44] The new law granted to the "industrious poor" the right to be relieved in their own homes even though they refused to be lodged in Workhouses and even though the parish had contracts with persons to provide relief and employment.[45]

According to the law of 1795 one Justice of the Peace could order relief for one month "and from time to time as occasion shall require." The benevolent policy of giving casual relief to persons in their own homes was maintained and extended during the period of the wars against France. The Militia Act of 1803 granted parish relief to the families of men serving in the army. Another reform in 1815 empowered the Justice of the Peace to order outdoor relief for more than one month but not exceeding three months.[46] The same law limited the amount of relief to three shillings a week or to three-fourths of that necessary to maintain a person in the Workhouse.[47]

The extent of the benefits derived from the new policy of granting casual relief outside the Workhouses was revealed by the Poor Law Returns of 1803. The total number of people in England and Wales receiving assistance in that year was 1,233,768; and of this total 956,248 persons received outdoor relief, while only 83,468 were relieved in Workhouses. Of the number receiving outdoor relief in 1803, 194,052 persons did not belong to the parishes which helped them.[48]

Both Pitt and Rose thought of the modification of the Laws of Settlement and Removal as one of their most beneficial reforms. Rose believed that the protection of Friendly Societies also benefited manufacturers and tradesmen.[49] In Pitt's thinking, the immobilizing of labor was the principal evil of the Elizabethan system. "The poor laws of this country," he said, "had contributed to fetter the circulation of labor. . . ." They had prevented the workman "from going to that market where he could dispose of his industry to the greatest advantage. . . ." By increasing the circulation of labor Pitt enthusiastically felt that "the wealth of the nation would be increased, the poor man rendered not only more comfortable but more virtuous, and the weight of the poor rates . . . greatly diminished."[50] Granting relief according to the number of children in the family, preventing removals at the caprice of the parish office, and compelling the poor to subscribe to the Friendly Societies—these reforms, he said, "would tend, in a very great degree, to remove every complaint to which the present partial remedy [a minimum wage] could be applied."[51]

The reformation of the Poor Laws had to give ground to the more crucial problems of waging war on a foreign front and marshalling economic resources at home. Early in 1793 England declared war on France. To equip the army and navy and to subsidize allies, the Government's expenditures greatly exceeded its revenues. Wartime inflation, the dislocation of trade, and a bad harvest brought the country to a crisis in 1795. Rioting, hungry mobs seized grain in transit and

[42] 49 Geo. III, c. 124. Nicholls (2: 142) says: "This was a humane provision and calculated to prevent great hardship."

[43] 36 Geo. III, c. 23. "An Act to amend so much of an Act made in the ninth year of George I . . . as prevents the occasional relief to poor persons in their own houses. . . ."

[44] Rose, J. Holland, *Pitt and Napoleon: essays and letters*, 84, London, George Bell, 1912. Rose felt obliged to apologize for Pitt's weakness in giving aid to the "industrious poor."

[45] This Act of 1795 had no connection with the "Speenhamland system," as the Hammonds supposed in *The village labourer*, 162-164, London, Longmans, 1911.

[46] 43 Geo. III, c. 47. See Nicholls, *op. cit.* 2: 135.

[47] 55 Geo. III, c. 137.

[48] *Abstract of returns* (1804), 716.

[49] Rose, *Observations on friendly societies*, 10-15.

[50] *Parliamentary history* 32: 709.

[51] *Ibid.*, 710.

threatened to disrupt the flow of military materials.[52]

When parliament convened in October, 1795, the King's speech expressed alarm over the high price of provisions. To cope with the emergency Pitt obtained a committee to investigate the price of wheat.[53] Members of the Committee, William Wilberforce and Dudley Ryder, introduced in Parliament and obtained the adoption of a resolution calling for the formation of an association among the upper classes, which would take pledges from them, to reduce their consumption of wheat flour by one-third. Familiar with the dietary experiments of Count Rumford, Ryder and Wilberforce recommended also the consumption of bread made from other than wheat flour.[54]

The Tory government, however, could not rely upon voluntary measures to obtain an adequate food supply during the dearth of 1795. It placed bounties on the importation of food including sugar, grain, and potatoes, and repealed the bounties on the exportation of sugar. It legalized the making of bread from flour of mixed grains and potatoes. To increase further the supply of food, it prevented the distilleries from making wines and spirits from all types of grain, malt, and potatoes.[55]

Since the rising prices of 1795 brought the Guardians of the Poor, which had been incorporated under the Gilbert Act and numerous Local Acts, to virtual bankruptcy, it was necessary for Parliament to enact special legislation to enable them to remain solvent.[56] With the expectation that efficient management would reduce Poor Law expenses, Gilbert had previously placed a ceiling over the assessment of Poor Rates. After the Poor Law Returns for the year, 1783 to 1785, he had taken the medium expenditures of those years as the maximum for future assessments. While thus limiting the Guardians' revenues, the law enabled them to borrow money to build Workhouses and made them responsible for the repayment of the loans as well as for the administration of relief.[57] Parliament now came to the relief of the Guardians by lifting the ceiling on assessments. The law, enacted late in 1795, enabled them to increase the assessments in proportion to the rise in the price of wheat but not more than double the medium expenditures for the years 1783 to 1785. One clause placed a new ceiling over assessments by requiring that, after January 1, 1798, "the sum to be assessed . . . shall never exceed in any one year the amount double the sum at present raised by virtue of this Act." However, the cost of living continued to rise and when the harvest failed in 1799, Parliament again raised the ceiling on assessments in proportion to the rise in the price of wheat. The permission to increase assessments according to the rise in the price of wheat was limited to January 1, 1802. But even this ceiling was not high enough to allow the adjustment of rates to prices; and Parliament consequently removed the ceiling "to enable the Guardians to pay the debts on Workhouses."[58]

During the crisis of 1795 the Foxite Whigs, a small but virile minority, continually harassed the Tory Government, demanding the restoration of peace and plenty.[59] The practical and benevolent Samuel Whitbread, upon whom the burdens of the poor weighed as heavily as upon Wilberforce, proposed a minimum wage as the proper remedy for the ills attending wartime inflation. Using Richard Price's index of the cost of provisions, he estimated that prices over a long period of time had far outdistanced wages. While conceding the natural law doctrine that prices and wages, like water, should be left to find their own level, he insisted that something be done to lessen the hardships of the working classes. His remedy was a minimum wage. From the time of Elizabeth I the Magistrates had possessed power to regulate wages. This power they had occasionally used to prevent the combination of workers by setting a maximum wage. Whitbread, on the other hand, proposed that the Magistrates use the same power to benefit the working classes by fixing a minimum wage in proportion to the rise in the price of wheat.[60]

The Whig leaders, Fox and Sheridan, who supported Whitbread's bill for a minimum wage, weakened their case by making concession to the natural law doctrine of noninterference. Pitt was quick to exploit their concession. In refuting the arguments for a minimum wage, he invoked the name of Adam Smith against such interference.[61]

[52] Briggs, Asa, *The age of improvement*, chapter 3, London, Longmans, 1959.
[53] *Parliamentary history* **32**: 235.
[54] *Ibid.*, 690.
[55] 36 Geo. III, c. 20.
[56] 36 Geo. III, c. 10.
[57] 22 Geo. III, c. 83.
[58] 42 Geo. III, c. 74. The law applied only to incorporated places.
[59] *Parliamentary history* **32**: 239.
[60] *Ibid.*, 701–703.
[61] *Ibid.*, 706.

To strengthen the natural law doctrine that wages and prices should be left to find their own level, it was necessary for Pitt to discredit Richard Price's cost of living index. He doubted the reliability of the index, because the people's habits of consumption had so changed that the price of wheat was no longer a reliable guide to the cost of living. Although readily granting the severe conditions of the working classes, Pitt was unwilling to interfere with manufacturing and trade by regulating wages. Parliament, therefore, rejected the minimum wage.

Outside Parliament the principal defense of the Whigs' minimum wage was made by the Reverend John Howlett. While acknowledging Pitt's eminent abilities, Howlett deigned to refute him because "some of his leading ideas were directly opposed to those he had long imagined to be so clear and evident as to be kind of first principles altogether indubitable."[62] "An indubitable maxim and of universal application," Howlett thought, is "that everything will be dear or cheap as it is scare or plentiful." From this self-evident proposition he had no difficulty in deriving the policy of regulating wages: "If hands be numerous and the demand for labor comparatively great, it will be dear. If hands be numerous and demand for labor comparatively small, labor will be cheap." It was clear to Howlett, that there was "a superabundance of hands" coming from an ever-increasing population. The only alternative to the Providential checks on the supply of laborers was an increase in demand for labor. He would increase the demand for labor by fixing a minimum wage that would break up the combination of employers.[63] If this were done, he reasoned, wages would return to their natural level and England would escape from the Providential visitation of sword, famine, or pestilence, otherwise necessary to wipe out the surplus labor.

All the arguments for the minimum wage left Pitt unconvinced. But he desired to do something to reduce the obvious miseries of the working people. Rather than interfere with wages, he preferred to reform the Poor Laws. In general, his proposed reforms perpetuated the humanitarianism of Thomas Gilbert. Pitt's first desire was to increase the mobility of labor by relaxing the Laws of Settlement and by granting casual outdoor relief. He wished to reward large families by giving relief, as a right, to those having more than two children and to widows with more than one child. He proposed schools of industry to educate the children of the poor. He would repeal the law requiring the workers to give up their last shilling of property before obtaining relief and he would grant occasional relief to people with property worth less than thirty pounds. He also proposed the granting of credit to the poor for the purchase of a cow or other capital which would help them to help themselves. In making these benevolent proposals, Pitt assumed that he was restoring the Elizabethan law to its original purity.[64]

Early in 1796 Pitt printed his Poor Law Reform Bill. Comprehensive in scope and humanitarian in spirit, it attempted so much that it aroused opposition in many quarters.[65] The provisions calling for larger expenditures and greater capital outlays alarmed parish officers who were already overwhelmed by the increasing demands for relief. Confronted with strong opposition, Pitt abandoned his omnibus bill but he did not relinquish his principles or relax his purpose. The reforms which he had suggested were enacted bit by bit during the next decade; and even after his death his closest friends, as a tribute to his memory, wrote into the law several reforms which he had proposed in 1796.[66]

To overcome the opposition to Pitt's Bill, the humanitarian reformers organized the Society for Bettering the Condition of the Poor. William Wilberforce took the initiative in the formation of this Society, as he had done on other occasions to promote good causes. An intimate friend of Pitt, Wilberforce was the leader of the humanitarians in Parliament and the national leader of the movement to abolish the slave trade.[67] After communicating with his Clapham friends, he invited a group of philanthropists to meet at his house in December, 1796, to form an organization like the Abolitionist Society. The original meeting was summoned by a circular letter signed by Wilberforce, Edward Eliot, and Thomas Bernard. The purpose of the Society, as stated

[62] Howlett, John, *Examination of Mr. Pitt's speech . . . relative to the condition of the poor*, 2, London, 1796.

[63] *Ibid.*, 21.

[64] *Parliamentary history* **32**: 707–709.

[65] Rose, George, *Observations on banks for savings*, 2, London, 1816.

[66] Bernard, Thomas, *A letter to the Bishop of Durham. . . .*, 60 London, 1807.

[67] Rose, J. H., *William Pitt and the national revival*, 294, and R. Coupland, Reginald, *Wilberforce*, 257–264, Oxford, Clarendon Press, 1923.

in the letter, was "to remove the difficulties attending parochial relief and the discouragement of industry and economy by the present mode of distributing it, to correct abuses of Workhouses, and to assist the poor in placing out their children in the world."[68] To uplift the people morally was the ultimate object set forth: "in proportion as we can multiply domestic comforts in the same degree we can hope to promote the cause of morality and virtue."[69]

Organized after the pattern of a score of evangelical societies, the new institution had Barrington Shute, the Bishop of Durham, as its President; William Wilberforce, as one of its Vice Presidents; and Thomas Bernard as its Secretary and spokesman.[70]

The leader of the new Society, Thomas Bernard, was the son of Sir Thomas Bernard, who had served as colonial Governor of New Jersey and later of Massachusetts. Born in 1750, the younger Thomas Bernard was educated at Harvard College before he began to study law at Lincoln's Inn. After marrying into a wealthy family, Bernard deserted law and devoted the rest of his life to charity. Like Jonas Hanway, he served as treasurer of the Foundling Hospital. As chairman of the Petty Sessions for the Hundred of Stoke in Bucks, he watched over the administration of the Poor Laws.[71]

Who were the poor people to whose welfare Bernard dedicated himself? "We mean by the poor," he said in a charge to the Overseers of Stoke, "those who have not the advantage of any profession, trade, property, or income, nor other means of support except their daily labor."[72] What did Bernard expect the Overseers to do for the poor? He charged them to be "the guardian and protector of the poor and as such to provide employment for those who can work and relief and support for those who cannot; to place the young in a way of obtaining a livelihood by their industry and to enable the aged to close their labours and their life in peace and comfort." He entreated Overseers to educate the young outside the Workhouse and warned them against defaulting in their duties by farming the poor to contractors. He also exhorted the Overseers not to remove laborers lacking a legal settlement, when "all they want is a little temporary relief."[73] Such was the humanitarian spirit of Thomas Bernard and the character of the reforms which he advocated for more than a decade.

Although Bernard and the Society for Bettering the Condition and Increasing the Comfort of the Poor did not prevent the defeat of William Pitt's bill, they took it up piece by piece and helped to enact many of its provisions into law. In its benevolent activities on behalf of Pitt's bill, the Society met with strong opposition from the natural law theorists.[74]

One of the ablest and best informed natural law opponents of Pitt's bill was Sir Frederick Morton Eden. When he published in 1797 his three-volume history, *The State of the Poor*, he included Pitt's bill, with Howlett's criticism of it, in his appendices. In the preface to his work, which he wrote in December, 1796, he summarily rejected the humanitarian reforms of both Pitt and Gilbert.

The low wages and rising prices of 1795 induced Eden to investigate the condition of the laboring classes. The alarming conditions which he discovered and reported in his three volumes convinced him that the main cause of these bad conditions was the "profusion" of the Poor Rates.[75]

Eden much preferred agriculture to industry and rural labor to urban. Whereas Gilbert's reforms had been designed to apply to rural parishes the efficient management of the urban Guardians, Eden began by denying that the farm worker was worse off than the urban laborer. From what classes do paupers come, he asked; and replied confidently "that paupers, comparatively speaking, are but rarely found among those employed in agriculture. . . ." If manufacturing labor earned higher wages than workers in agriculture, the fair inference seemed to be that it is "the result of that marked favor shown to commerce in preference to the landed interest which many suppose to have long prevailed in our national councils."[76]

Whereas the humanitarians were determined

[68] Society for Bettering the Condition and Increasing the Comforts of the Poor, *Reports* 1: 390, 5th ed., London, 1805.

[69] Baker, James, *The life of Sir Thomas Bernard*, 17, London, 1819.

[70] *Reports* 1: 4.

[71] Holyoake, George Jacob, *Self-help a hundred years ago*, 14–15, London, 1888.

[72] *Reports* 1: 381.

[73] *Ibid.*, 387.

[74] Bernard, *Letter to the Bishop of Durham*, 60–62.

[75] Eden, Frederick Morton, *The state of the poor* 1: 580, London, 1797.

[76] *Ibid.* 1: ix.

to abolish the system of contracting the poor, Eden pronounced it "the greatest improvement of modern times" because its reduction of the rates "must be confessed to have been extraordinary." At the same time he pointed out the failures of the incorporated places under the Gilbert Act; he found their houses of industry experiencing "the common fate of all the plans hitherto attempted for the management of the poor. . . ." [77]

Although Eden amassed considerable practical information about the living conditions of the poor, he did not draw conclusions from such information. His condemnation of the Poor Laws was *a priori;* for example, his objections to public provision of employment stemmed from economic theory. The Elizabethan requirement that the parishes provide employment for the able-bodied, he said, "proceeded from the supposed existence of facts in political economy, which was doubtful at the time, but which experience has since proved to be mistaken. It is a most satisfying circumstance . . . to show that the capital stock of the public cannot enter into competition with the capital and well-exerted industry of individuals. . . ." [78]

Invoking Adam Smith's wage-fund theory, Eden redirected the natural law criticism of the Poor Laws. Previously the principal argument had been against the Law of Settlement, which supposedly immobilized labor. Eden frankly denied that the Poor Laws had restricted the movement of labor. He preferred to argue from the wage-fund theory that all compulsory payments to the poor came from employers' funds available for the payment of wages and for the employment of additional workers.[79] From this doctrinaire position he fired at Pitt's Bill. He even objected to the public provision of education as a calamitous waste of the nation's wealth. The maxim *pas trop gouverner*, he concluded, was fully illustrated by the operation of the Poor Laws, for "the system has insinuated itself into every crack and aperture of the edifice and, like spreading ivy, has at length overshadowed the building that supported it. . . ." Since "the plans and schemes of Poor Laws were costly beyond all calculation," Eden concluded that the only remedy was a definite limit to expenditures, looking forward to the substitution of Friendly Societies for the Poor Laws. "The inveteracy and malignity of the malady has been such that the best medicine has only checked it; a radical and complete cure is within the competency only of the legislature." [80] Eden's natural law remedy for the disease was the substitution of voluntary charity and self-help for the Poor Laws.

While Eden was resisting the Government's measures to improve the conditions of the poor, the prosecution of the war with France increased inflation and aggravated the miseries of the working classes. Continued deficit spending and the rapid expansion of commercial credit compelled the Government, in 1797, to suspend the payment of specie.[81] When the harvests failed in 1799 and 1800, the nation was again threatened by famine. With the news of a bad harvest the price of wheat rose from 48*s.* a quarter in 1798 to 79*s.* in October, 1799.[82] To meet this crisis, the Government again stopped the distilleries, prohibited the exportation of food, and placed bounties on the importation of grain, flour, and rice.[83]

At this crisis Samuel Whitbread introduced a second bill calling for a minimum wage and Pitt again refused to accept his measure because "it was legislative interference into that which ought to be allowed to take its natural course." [84]

In the second controversy over the minimum wage, Thomas Bernard produced a tract in support of Pitt's position. He arrayed statistics on the price of wheat and the wages of labor to demonstrate—at least to his own satisfaction—the impossibility of regulating wages in proportion to the price of wheat. According to his estimation, rural wages remained in 1800 at 9*s.* a week or about at the level of 1780; over the same period of time the quartern loaf of bread rose from 6*d.* to 1*s.*9*d.* To have increased wages proportionately would have brought them to a level of 25*s.* a week, a rate far above what Bernard thought manufacturers could afford to pay. He concluded that it was fortunate, indeed,

[77] *Ibid.* **1**: v.

[78] *Ibid.* **1**: 586.

[79] For Adam Smith's wage-fund theory, see *The wealth of nations*, 69.

[80] Eden, *op. cit.* **1**: xxv.

[81] Tooke, Thomas, *A history of prices*, 213, London, 1838. See also Arthur D. Gayer, W. W. Rostow, and Anna J. Schwartz, *The growth and fluctuation of the British economy, 1790-1850* **1**: 54, Oxford, Clarendon Press, 1953.

[82] The peak of 136*s.* was reached in July, 1800. See the *First reports of the Committee to Consider the High Price of Provisions* (1800), 9-10.

[83] *Parliamentary history* **35**: 791.

[84] *Ibid.*, 1439.

that the price of labor depended upon supply and demand rather than upon "laws and lawgivers." [85]

In opposition to Pitt's Poor Law policy, the famine years called forth Robert Malthus's tract, "An Investigation into the Present High Price of Provisions." Having already published his *Essay on Population*, he turned now to apply the principles of population to explain lagging wages and rising prices. The growth of population, he thought, was "the real cause of the continued depression and poverty of the lower classes of society and of the total inadequacy of all the present establishments in their favour to relieve them, and to the periodical return of such seasons of distress as we have of late experienced." [86] Malthus pointed to the Poor Law "allowances in proportion to the price of corn" as the sole cause which has occasioned the price of provisions to rise so much higher than the degree of scarcity would seem to warrant. . . ." [87]

Only the Government and the grain dealers knew the extent of the dearth in 1799 and the grave threat of starvation that came with another bad harvest in 1800. The price of wheat fluctuated so widely during these years that no Guardian or Overseer could have granted relief in proportion to the price of bread and have remained solvent. To deal with the famine conditions, the Government appointed a Committee on the High Price of Provisions. Its reports revealed the seriousness of the famine. During the preceding decade the annual average consumption of wheat had been 7 million quarters, and the domestic yield 6.7 million. The Committee estimated the harvest of 1800 as only 5 million quarters. With so large a deficiency the Government, even if it were able to import more than ever before, would have to find substitutes for bread.[88]

In the House of Commons, Dudley Ryder, the Chairman of the Committee on the High Price of Provisions, recommended several of the practices of the Society for Bettering the Conditions of the Poor. The Committee recommended the making of bread from coarse and mixed flour. It encouraged the fishing industry by supplying duty-free salt. Most of these recommendations were adopted by the Tory Government to meet the threat of famine.[89]

Out of the crisis caused by high prices came the proposition to enumerate the people. Whether population was increasing or decreasing had become a hot political question. Believing that the population was declining, the Whigs censured the Tory Government for waging war against a country so powerful and populous as France.[90] To put an end to the controversy, Charles Abbot introduced his census bill. "In times like these," he said, "when the subsistence of the people is in question, this knowledge becomes of the highest importance. It is surely important to know the extent of the demand for which we are to provide a supply." [91] With the assistance of Wilberforce, Abbot's bill became law. The census of 1801, showing a population of about nine million people in England and Wales, confirmed the arguments of those who feared the consequences of an increasing population.

Chief among those fearing the increase in population was the Reverend Robert Malthus. In 1798 Malthus published *An Essay on the Principle of Population as it Affects the Future Improvement of Society with Remarks on the Speculation of Mr. Godwin, M. Condorcet, and other Writers.* The *Essay* had been written especially to refute William Godwin's optimistic view of social progress. In the preface to his *Essay*, Malthus apologized for a view of life with such a "melancholy hue" but he held the view because he thought "these dark tints . . . are really in the picture." He thought this gloomy picture accounted for "much of that poverty and misery observable among the lower classes of people in every nation and for those reiterated failures in the efforts of the higher classes to relieve them." [92]

When Malthus wrote the *Essay*, he was situated in a country parsonage with only three or four books at hand. Among these was Adam Smith's *The Wealth of Nations.* Malthus developed at length Smith's observation: "Every species of animals naturally multiplies in proportion to the means of their subsistence, and no species can ever multiply beyond it." Malthus also assumed Smith's wage-fund theory. Wages should be naturally determined, Malthus thought; and if the rich paid poor rates they would have

[85] Society for Bettering the Condition of the Poor, *Reports* **5**: 154–157.

[86] Malthus, *An investigation of the present high price of provisions*, 27, London, 1800.

[87] *Ibid.*, 4–5.

[88] *Parliamentary history* **35**: 825.

[89] 41 Geo. III, c. 12.

[90] *Parliamentary history* **31**: 1354.

[91] *Ibid.* **35**: 598.

[92] Malthus, *Essay*, iii, 2nd ed., 1803.

less for wages and employment. Although Malthus had derived his principle of population *a priori*, even before the first census had been taken, he confidently applied it to society. In the second edition of his *Essay*, published in 1803, he turned the principle of population against the Poor Laws. Their first obvious tendency he said is to increase the population without increasing the food for its support. Since the Poor Laws encourage early marriage, he said, "they may be said to create the poor which they maintain."[93]

The bold and sweeping attacks of Eden and Malthus upon the Poor Laws threw the humanitarian reformers on the defensive. To meet the new attacks, greater factual information was needed. Acting with prudence and caution, George Rose, who had helped to initiate the first census of population, called for an inquiry into the Poor Laws. In 1803 Parliament, complying with his request, ordered the 16,000 parishes to return information relating to the conditions of the poor. A careful administrator, Rose requested information directly bearing on policy. Always interested in the welfare of the Friendly Societies, he inquired about the number of such Societies and the number of their members. Seeking a clue to the mobility of labor, he asked how many persons were relieved occasionally and how many of those were without a legal residence. Desiring more light on Gilbert's policy of encouraging outdoor relief, Rose asked for the number of people permanently relieved inside and outside the Workhouses; and how many of those permanently relieved were aged, infirm, or children. His systematic investigation supplied more information on the operation of the Poor Laws than had ever been available before and knowledge accurate enough to correct some of the misrepresentations of the natural law reformers.

Neither an eloquent speaker nor a fluent writer, Rose spoke in the House of Commons briefly and rarely; but as a devoted civil servant he wrote occasional tracts, based upon Treasury statistics, to inform Members of Parliament and to refute the criticism of Pitt's policies. His knowledge of the growing national wealth gave him the optimism of a prosperous businessman, and his optimism sustained the less sanguine Pitt during the dark years of war and famine.[94] With similar optimism, Rose produced a tract, based upon the Poor Law Returns of 1803, to defend Pitt's Poor Law policy. In considerable detail he answered the criticisms of Malthus and Eden, both of whom had advocated a total, though gradual, abolition of the Poor Laws. Malthus recommended that no child born a year after the enactment of his reform be given relief. Eden proposed to substitute the self-help of Friendly Societies for compulsory relief. Although opposed by able critics, Rose defended the Elizabethan system as coming from the "wisest councils . . . in any period of our history." If the lapse of time and the progressive improvement of the country might call for changes in detail, "yet it is believed the general principles are still founded in wisdom and its regulations suited to the unvarying rules of human nature and the ordinary course of political society."[95]

Somewhat disturbed by the increase in Poor Law expenditures, Rose related the growth of expenditures to the increase in population and the rise in the cost of living; whereas Malthus, on the other hand, attributed both the increase in population and the rise in prices to excessive Poor Law expenditures. In addition, Rose was aware that the "fluctuations in manufactures, risks attendant on trade . . ., must reduce many to indigence." By the Returns of 1803, he also attempted to refute the charge of "profusion" and to correct the misinformation about the increase in Poor Rates. Eden had dramatized the wanton extravagance of the Berkshire scale. Malthus reported: "The Poor Rates in many parishes increased from 4*s*. in the pound to twelve, and the price of wheat necessarily kept pace with them. . . ." That there were hardships in certain parishes observed by Malthus, Rose did not deny, for he knew that many cases of hardship were due to low assessments. The Returns of 1803 showed that the rated rentals were generally three-fourths or less of the actual rentals. From the returns made to the Tax Office (on which national taxes were based), Rose calculated the actual rate in the pound as *2s*.10*d*.[96]

Malthus's proposal to raise wages, by reducing the number of marriages, greatly alarmed Rose. "At a time when, from the situation in which we

[93] *Ibid.*, 400–410.

[94] See Rose, *A brief examination into the increase of the revenue, commerce and manufactures of Great Britain from 1792 to 1799*, London, 1799. Because he was a friend of the poor, he was the most persistent Tory advocate of the income tax.

[95] Rose, George, *Observations on the poor laws and on the management of the poor*, 1, London, 1805.

[96] *Ibid.*, 41.

are placed with respect to our most dangerous enemy," he said, "the number of our people are become as necessary for our defense as for the increase of our wealth and prosperity."[97] Rose could not wish for a decrease of manpower during wartime or for an increase in wages, which he feared would prevent British manufacturers from selling their goods overseas. In concluding his observations on the Returns of 1803, Rose declared: "My wish is to see an improvement in the execution of the Poor Laws aided by further legislative provisions instead of an annihilation of their powers."[98]

The Returns of 1803 showed the success of Gilbert's policy in transforming the Workhouses from places of employing the able-bodied to residences for children, the aged and infirm. By 1803 most of the Workhouses had become Poorhouses. Of more than a million recipients of relief, only 83,000 received assistance indoors; and although 3,765 places reported having Workhouses, they had spent less than 50,000 pounds on the purchase of materials to put people to work. The contract system, which had been widespread before Gilbert's reforms, had been abandoned in all but 293 places.[99]

Pitt and subsequent Tory Governments continued the transformation of the Workhouses into Poorhouses. In 1796 Pitt extended the benevolent provisions of the Gilbert Act to all parishes by repealing the law which required persons to accept relief indoors. The reform of 1810 empowered the Justices of the Peace to regulate all the Poorhouses according to the rules of the Gilbert Act.[100] The original Workhouse act of 1723 had enabled the parish "to contract with some person to keep and employ the poor and take the profits of their labor." Finding the contract system still in existence, the humanitarian reformers struck a blow at it in 1805 by requiring the contractor to be a resident of the parish where the poor were maintained, to have his contract approved by two Justices, and to give security that the provisions of the contract would be fulfilled.[101] Another reform in 1810 deprived the Overseers of jurisdiction over the contractors by making the latter directly accountable to the Justices. In 1816 a law prohibited the contracting of adults and at the same time reduced the supply of adult labor in the Workhouse by repealing all the laws since the time of George I which required people to maintain themselves in the Workhouses until their debts were paid.[102]

The humanitarian's sentimental attachment to the working classes was expressed in several other acts which lifted them from their degradation. Since the time of William III, the parish had tried to deter poverty by badging the poor with the letter "P" and the initial of the particular parish. In 1810 the humanitarian reformers abolished the badging of the poor.[103]

Corporal punishment of the working classes had long been practiced as a means of deterence and of discipline within the Workhouse. The humanitarians, who so earnestly wished to abolish the brutality of the slave trade, desired also to eliminate the physical punishment of the "crime of poverty." Characteristic of their humane sentiment, they first prohibited the public punishment of females. A law of 1814 prohibited all corporal punishment of the poor by Churchwardens, Overseers, and Guardians.[104] The same law limited to twenty-four hours the confinement of anyone as punishment for his poverty. Two years later another benevolent law specified that no person of sane mind should be confined in chains.[105]

The death of Pitt in 1806 did not put an end to the humanitarian reform of the Poor Law. When Samuel Whitbread introduced his Poor Law Bill in 1807, Sir Thomas Bernard censured him for proposing reforms less benevolent than those of Pitt's Bill. At the same time, he approved of the provisions which were common to both bills. He approved of boarding infants with friends or relatives rather than maintaining them in Workhouses. He approved of allowing occasional relief to laborers without dispossessing them of their small property; and he specified that such relief should not be restricted to times of sickness. Pitt had recommended in 1796 the rewarding of families who reared more than two children; and Bernard preferred this provision to Whitbread's proposal to reward families having reared six or more children to the age of fourteen. It is clear from Bernard's letter to the Bishop of Durham that the Society for Bettering

[97] *Ibid.*, 6; and Malthus, *Essay*, 2nd ed., 510.
[98] Rose, *Observations*, 44.
[99] *Abstract of returns* (1804), 716.
[100] 50 Geo. III, c. 50.
[101] 45 Geo. III, c. 54.
[102] 56 Geo. III, c. 129.
[103] 53 Geo. III, c. 52.
[104] 54 Geo. III, c. 170.
[105] 56 Geo. III, c. 129.

the Condition of the Poor was still seeking in 1807 to enact the benevolent reforms that Pitt had recommended ten years earlier.[106]

The conflict between the humanitarians and the natural law reformers extended to the detailed administration of the Poor Laws. Thomas Gisborne, one of the most influential humanitarian authors, urged the Magistrates to be true guardians of the poor, protecting them from the parsimony of the Overseers.[107] Nearly all the reforms from 1782 to 1815 had been designed to increase the authority of the Magistrates and the Justices over the parish officers. The natural law reformers, on the other hand, preferred the parsimony of the Overseers to the benevolence of the Justices, whom they pictured as warmhearted, seeking to do good, but not alert to the long-run consequences of their "profusion." Undoubtedly, both groups of reformers, in their eagerness to justify their particular reforms, exaggerated the benevolence of the Justices and the parsimony of the Overseers.

That a system so comprehensive as the Elizabethan Poor Laws collided again and again with the tough mind of avarice should be readily conceded. The critics of the Poor Laws, conscious of paying the costs, were always more articulate than the working classes who derived benefit from them. It was fortunate for the English working classes that the humanitarian reformers advocated their welfare and ameliorated some of the harsh conditions of the Poor Laws. At a time of rapid industrialization the humanitarian reforms made it easier for the workers to move to places of employment and be more secure in their new residences. The granting of outdoor relief to the sick and to large families lessened somewhat the harsh conditions attending the years of wartime inflation. Although the benevolent reforms mitigated conditions somewhat, they also serve to emphasize the enormous amount of misery which the working people endured during the period of the wars against France.

[106] Bernard, *Letter to the Bishop of Durham*, 60-62.
[107] Gisborne, *op. cit.* 1: 436-440.

VARIABLES EXPLAINED AWAY

WILLARD V. QUINE

Edgar Pierce Professor of Philosophy, Harvard University

(*Read April 22, 1960*)

As x increases, we are told, $2/x$ decreases. Since numbers never increase or decrease, such talk of variables must be taken metaphorically. The meaning of this example is of course simply the general statement that if $x > y$ then $2/x < 2/y$. Indeed logicians and mathematicians nowadays use the word 'variable' mostly without regard to its etymological metaphor; they apply the word merely to the essentially pronominal letters 'x,' 'y,' etc., such as are used in making general statements and existence statements about numbers. A characteristic use of such letters is seen in the generality prefix 'every number x is such that,' followed by some sentence, usually of the conditional or 'if-then' form, containing the letter 'x.' Another characteristic use of such letters is seen in the existence prefix 'some (at least one) number x is such that.'

The familiar form of stipulation 'Let x be thus and so' is usually best construed as amounting to a generality prefix and an 'if'-clause. Ordinarily the stipulation prefaces some passage of mathematical reasoning; and this whole combination can be treated as a generalized conditional sentence beginning 'Every number x is such that if x is thus and so then'—and continuing with the main body of the passage of reasoning in question.

The use of 'x' as an unknown in mathematical problems comes to the same thing. Such a problem starts out with some initial condition on x. Solving such a problem consists in finding an equation, '$x = \ldots$,' worthy of standing as the 'then'-clause of a generalized conditional sentence whose 'if' clause states the given initial condition.

Mathematicians often introduce further letters in the role of unspecified constants or so-called parameters, in explicit contrast to the so-called variables such as 'x' and 'y.' Logically these parameters can be looked upon still as variables, and contrasted with 'x' and 'y' merely in respect of how much text the general sentences or existence sentences take in. A typical page involving 'a' as a so-called parameter, and 'x' as a variable explicitly so-called, might be analyzed in the following fashion. The whole is governed by the implicit generality prefix 'every number a is such that.' Then one or more briefer subsidiary clauses are governed by more transitory prefixes 'every number x is such that' or 'some number x is such that.' Typical talk of parameters can be construed along this line without essential difficulty.

Variables, of course lend themselves to discourse not only of numbers but of objects of any sort. The non-numerical prefixes 'every set x is such that,' 'every person x is such that,' 'some country x is such that,' have equal rights with the prefixes that talk of numbers.

Nor are variables necessarily tied up with generality prefixes or existence prefixes at all. Basically the variable is best seen as an abstractive pronoun: a device for marking positions in a sentence, with a view to abstracting the rest of the sentence as predicate. Thus consider the existence statements 'Some number x is such that x is prime' and 'Some number x is such that $x^3 = 3x$.' The variable is conveniently dropped from the first: we may better say simply 'Some number is prime,' because in 'x is prime' the predicate 'is prime' is already nicely segregated for separate use. The variable can be eliminated also from the second example, but less conveniently: we could say 'Some number gives the same result when cubed as when trebled,' thus torturing the desired complex predicate out of '$x^3 = 3x$' with a modicum of verbal ingenuity. In more complex examples, finally, use of 'x' is the only easy way of abstracting the jagged sort of predicate which we are trying to say that some number fulfills. Where the variable pays off is as a device for segregating or abstracting a desired predicate by exhibiting the predicate sentencewise with the variable for blanks.

The variable is invaluable still as abstractive pronoun in places where generality and existence are not the point. Thus consider singular descriptions, as logicians call them: phrases beginning with the singular 'the.' We say 'the square of 2,' 'the author of *Waverley*,' without variables; but in 'the number x such that,' followed by some complex condition on 'x,' we need the variable as ab-

stractive pronoun just as urgently as in the corresponding existence statement.

As a point now of theory and not of practical convenience, it can be interesting to inquire whether the variable is in principle dispensable. We were able to avoid the variable as abstractive pronoun in the case of '$x^3 = 3x$' by torturing '$x^3 = 3x$' into 'x gives the same result when cubed as when trebled.' Once we had coaxed the dummy letter 'x' thus into suitable position and segregated the rest, we ceased to need the 'x.' In this example the coaxing depended on such auxiliary words as 'gives,' 'result,' and 'when,' along with participial endings of verbs. Now my question is whether a general, finite battery of such auxiliary operators can be assembled that will enable us always to coax variables thus into positions where we can dispense with them.

The answer is affirmative, as I shall show. The interest in carrying out the elimination is that the device of the variable thereby receives, in a sense, its full and explicit analysis. There is no thought of denying ourselves the continuing convenience of variables in practice.

I shall need henceforward to talk continually of *predicates* and *predication* in the following regimented way. An *n*-place predicate is a sign that attaches to a string of *n* subjects to make a sentence; and a sentence so formed is called a predication. Thus we may have a three-place predicate 'F' of distance comparison, where the predication '$Fxyz$' means that x is farther from y than from z. We may have a two-place predicate 'B' of biting, where the predication 'Bxy' means that x bites y. We may have a one-place predicate 'D' of doghood, where 'Dx' means that x is a dog. A no-place predicate, if we may force our terminology a bit, would be a sentence as it stands.

Given the two-place predicate 'B,' which is the transitive verb 'bites,' let us now contrast two styles in which we might say that x bites something. The one style uses an existence prefix; the other style uses a certain operator on predicates. The one style is familiar, and consists in two steps: first we form a predication 'Bxy' and then we apply to it the existence prefix 'Something y is such that.' The other style is opposite in order: first we make a new predicate, a one-place predicate meaning 'bites something,' and then we use it and 'x' to form a predication 'x bites something.' For this style we need an operator which can be applied to a two-place predicate or transitive verb 'B,' 'bites,' to produce a one-place predicate 'bites something.' Let us call this operator that of *derelativization* and write it 'Der.' Thus 'Der B' is the one-place predicate or intransitive verb of biting, or biting something, and the predication '(Der B)x' means that x bites something.

I remarked that the essential utility of variables is that they mark positions. This point becomes vivid when we contrast the derelativization operator with the existence prefix, which used a variable 'y.' The two devices are alike in enabling us to say that x bites something. But the existence prefix with its variable has the advantage of enabling us to say also such further things as that

Something x is such that something y is such that Bxy,
Something y is such that Byx,
Something y is such that Byy,

whereas our derelativization operator only takes care of the case 'Something y is such that Bxy.' To make the derelativization operator suffice in lieu of existence prefixes and variables, what are needed are certain further operators capable of coaxing a variable into the right position. Also an extension of the derelativization operator itself is needed; let me begin with that.

So far I have explained derelativization as applying to a two-place predicate 'B,' 'bites,' to produce a one-place predicate 'Der B,' 'bites something.' Let us now explain it as applying similarly to a one-place predicate to produce a no-place predicate, or sentence, which simply affirms existence: 'Der D' means simply that there are dogs. Then, since '(Der B)x' means that x bites something, 'Der Der B' means that something bites something. This disposes of our example 'Something x is such that something y is such that Bxy.'

With an eye now to the next of the above examples, 'Something y is such that Byx,' we add an operator of *inversion*. This operator may be described as turning a transitive verb or two-place predicate from active to passive: '(Inv B)xy' means that Byx. Thus equipped, we can rectify 'Something y is such that Byx' to read 'Something y is such that (Inv B)xy,' whereupon we can bring derelativization to bear; the whole gets translated as '(Der Inv B)x,' devoid of the existence prefix and its 'y.'

Our further example 'Something y is such that Byy' prompts the adoption of yet a third operator, that of *reflection*. It turns the two-place predicate 'B,' 'bites,' into the one-place predicate 'Ref B,' 'bites self.' Thus '(Ref B)y' means 'Byy.' Then

instead of 'Something y is such that Byy' we can write 'Something y is such that (Ref B)y' and hence simply 'Der Ref B.'

These simple examples already illustrate the essential trick of the general elimination of variables. Let us now generalize.

Our three operators—'Der,' 'Inv,' 'Ref'—need to be generalized for application to predicates of more than two places. I shall generalize them in the least imaginative way, simply supplying the extra places as inert background. Even so, there are in the case of inversion two such generalizations both of which will be wanted. Altogether, then, our four operators on predicates may be described succinctly as follows, where 'P' represents any n-place predicate:

Derelativization: (Der P)$x_1 \ldots x_{n-1}$ if and only if there is something x_n such that $Px_1 \ldots x_n$.

Major inversion: (Inv P)$x_1 \ldots x_n$ if and only if $Px_nx_1 \ldots x_{n-1}$.

Minor inversion: (inv P)$x_1 \ldots x_n$ if and only if $Px_1 \ldots x_{n-2}x_nx_{n-1}$.

Reflection: (Ref P)$x_1 \ldots x_{n-1}$ if and only if $Px_1 \ldots x_{n-1}x_{n-1}$.

We saw that 'Something y is such that Bxy' and the three kindred examples could be rendered respectively as '(Der B)x,' 'Der Der B,' '(Der Inv B)x,' and 'Der Ref B.' Let us now try our four generalized operators on the more serious example:

> Something x is such that something y is such that $Pyxyx$.

By transforming the part '$Pyxyx$' first into '(inv P)$yxxy$,' thence into '(Inv inv P)$xxyy$,' and thence into '(Ref Inv inv P)xxy,' we reduce the whole sentence to:

> Something x is such that (Der Ref Inv inv P)xx,

which reduces in turn to:

Der Ref Der Ref Inv inv P.

More generally, we can claim this of our four operators: they enable us to get rid of existence prefixes and their variables whenever, as in the above example, there are only the existence prefixes and one predication. The reasoning is as follows. It is easily seen that major and minor inversion suffice to permute any number of subjects into any desired order; and then reflection suffices to resolve repetitions, when they are permuted to terminal position. Finally derelativization takes care of each existence prefix and its variable in terminal position.

We have still to worry about existence prefixes governing sentences which are compounded of predications, e.g. in the fashion 'Bxy and not $Fxxz$.' To handle such cases, we need these two further operators on predicates:

Negation: (Neg P)$x_1 \ldots x_m$ if and only if not ($Px_1 \ldots x_m$).

Cartesian multiplication: ($P \times Q$)$x_1 \ldots x_my_1 \ldots y_n$ if and only if $Px_1 \ldots x_m$ and $Qy_1 \ldots y_n$.

Using these, we can express our example 'Bxy and not $Fxxz$' as a single predication '($B \times$ Neg F)$xyxxz$.' (In reading this we have to know, of course, that 'B' is two-place and 'F' is three-place.)

Our operators on predicates are now six. They enable us to get rid of an existence prefix and its associated variable when what the prefix governs is constructed by 'not' and 'and,' as complexly as you please, from any number of predications.

I can put this more strongly. Suppose we have a language of the following form. Its simple sentences are predications, formed of predicates and strings of variables. Its compound sentences are built up of such predications by repeated use of just three devices: 'not,' 'and,' and existence prefixes. These prefixes are 'something x is such that,' 'something y is such that,' etc., with no restriction of the objects to special categories such as numbers or persons; the universe may be conceived widely or narrowly, but it is to be the same for every existence prefix. A language thus simply constituted I shall call *standard*. Standard languages differ from one another only in their stock of predicates and in how the universe is chosen. Now we can say this of our six operators on predicates: these, if added to a standard language, enable us to rid the language of existence prefixes and variables altogether. Briefly the reasoning is as follows. Given any sentence of a standard language, we go to work on an *innermost* existence prefix: one whose governed clause contains no existence prefixes. Our six operators on predicates enable us to eliminate it and its variable. Then we deal with any surviving innermost existence prefix, and, working thus outward, eventually make a clean sweep of all existence prefixes and their variables.

Thus consider the sentence 'Some men read no books.' In standard language it is:

Something x is such that (Mx and not something y is such that By and Rxy),

for obvious interpretations of 'M,' 'B,' and 'R.' Now the part 'By and Rxy' can be transformed successively thus:

$$(B \times R)yxy,$$
$$[\mathrm{Inv}(B \times R)]xyy,$$
$$[\mathrm{Ref}\ \mathrm{Inv}(B \times R)]xy.$$

The whole sentence 'Some men read no books' then becomes:

Something x is such that {Mx and not [Der Ref $\mathrm{Inv}(B \times R)$]x},

which can be further transformed into:

Something x is such that [$M \times$ Neg Der Ref $\mathrm{Inv}(B \times R)$]xx,

and finally into:

$$\mathrm{Der\ Ref}[M \times \mathrm{Neg\ Der\ Ref\ Inv}(B \times R)].$$

This, it will be said, is an illustration in miniature of how variables might be eliminated from serious theories. Actually it is more: it is already a solution of the general case.[1] For there is evidence that what I have called the standard form of language is, despite its apparent poverty, an adequate medium for scientific theories generally. Some illustrative translations will clarify this point.

Existence prefixes suffice to the exclusion of generality prefixes. Thus consider the generality prefix 'every number x is such that.' Using 'not' and an existence prefix, we can paraphrase it as 'not some number x is such that not.'

Existence prefixes suffice to the exclusion also of the prefixes of singular description. Thus consider the singular description 'the number x such that $x + x = x$.' Whenever it is used, it is used in one or another sentence that says something further about the described number; e.g., that it is less than 1. Now instead of saying that *the* number x, such that $x + x = x$, is less than 1, we can resort to an existence prefix and say merely that *some* number x is such that $x + x = x$ and $x < 1$. If with an eye to the 'the' of singular description we want also to affirm uniqueness—that only one number x is such that $x + x = x$—we can add a further sentence to that effect. It too can ultimately be formulated without using variables otherwise than in connection with existence prefixes.[2]

I urged earlier that the variable is best understood as an abstractive pronoun. Still one finds, as in these examples, that all contexts which call for variables can be warped around into ones in which variables are used solely with existence prefixes. Alternative paraphrases are available too, herding the variables into other types of construction; but we *can* rest with the existence prefixes.

We can do better: we can adhere to the unrestricted form of existence prefix 'something x is such that,' as against the restricted form 'some number x is such that' and the like. For, 'some number x is such that' can be paraphrased as 'something x is such that x is a number and.' Such, indeed, was our treatment of men and books in transforming 'Some men read no books.'

This much suffices perhaps to illustrate that the standard form of language is adequate so far as the role of variables is concerned. Variables can be seen as adjuncts purely of existence prefixes, and unrestricted ones at that.

Another economy of standard language was that apart from existence prefixes it recognizes only 'not' and 'and' as means of building sentences from sentences. Ways have long been familiar whereby 'not' and 'and' can be made to do the work of various further sentence connectives: 'p or q' can be rendered 'not (not p and not q),' and 'if p then q' can be rendered 'not (p and not q).'

[1] The first general elimination of variables was due to Schönfinkel, Moses, Ueber die Bausteine der mathematischen Logik, *Mathematische Annalen* **92**: 305–316, 1924. His operators operate on themselves and one another, whereas our six operate only on the original predicates and on the predicates thence derived by the operators. His presuppose an abstract universe equivalent to that of higher set theory, whereas ours make no ontological demands, being even retranslatable into 'not,' 'and,' and existence prefixes. An apparatus more nearly equivalent in scope to ours is Tarski's cylindrical algebra, when the number of its dimensions is taken as infinite; see Skolem, T., *et al.*, *Mathematical interpretations of formal systems*, Amsterdam, North-Holland Publishing Co., 1955, the chapter by Henkin, Leon. But here again there is a radical difference in approach. In a way our operators are reminiscent also of the axioms of class existence in Neumann, J. von, Eine Axiomatisierung der Mengenlehre, *Journal für reine und ungewandte Mathematik* **154**: 219–240, 1925, despite dissimilarity of purpose. See also my Toward a calculus of concepts, *Journal of Symbolic Logic* **1**: 2–25, 1936. Along Schönfinkel's line much research has meanwhile been done, mainly by Curry; see Curry, H. B., and Feys, Robert, *Combinatory logic*, Amsterdam, North-Holland Publishing Co., 1958.

[2] Not some number x is such that [$x + x = x$ and some number y is such that ($x \neq y$ and $y + y = y$)].

These and further reductions to what I have called the standard form are familiar to logicians.[3] All branches of classical mathematics can be put into standard form, and so can all other branches of theory that would be at all generally regarded as having attained to explicit scientific formulation. This is abundantly borne out by literature on the logical regimentation of mathematics and other scientific discourse.

Singular terms seem a mainstay of language. We continually use proper names, and also complex singular terms such as 'the author of *Waverley*' and '$x + y$.' It is worth noticing, then, that our standard form has none of these—no singular terms except the simple variables themselves. It has long been known that by suitable choice of predicates we can dispense with singular terms other than variables. The main step in that argument is the elimination of singular descriptions that was illustrated above.

And now our new reduction dispenses even with the variables. There cease to be singular terms at all; there remain only the predicates themselves and our six fixed operators upon them. Each sentence fares substantially as our example 'Some men read no books' was seen to fare.

It will be said that there may still survive, in examples other than that one, the sentential operators 'not' and 'and.' But we can disclaim these, for they are best viewed as merely those cases of 'Neg' and '$\times$' where the predicates to which 'Neg' and '$\times$' are applied happen to be no-place predicates, i.e., sentences.

We end up with a universal algebra purely of predicates, comprising just our six operators and any arbitrary predicates as generators for them to operate on. This is a general logical notation. It is devoid of variables, yet theoretically adequate as a framework for theories generally, mathematical and otherwise. To fix it as a notation for any specific subject matter we merely supply the appropriate vocabulary of specific predicates, leaving the outward framework unchanged; and that framework consists of our six operators, nothing more.

[3] The modern logic of *quantifiers*—i.e., generality prefixes and existence prefixes—dates from Frege, Gottlob, *Begriffsschrift*, Jena, 1879. So do the various reductions noted in the past few paragraphs, except that the eliminability of singular descriptions was noted rather by Russell, Bertrand, On denoting, *Mind* **14**: 479–493, 1905.

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